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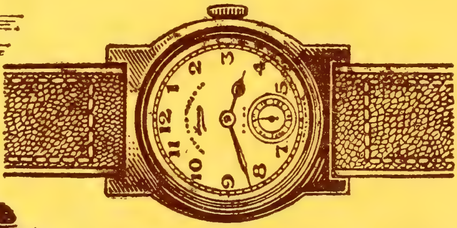

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JUNGLE MEMORIES

BY

Lt.-Col. E. G. Phythian-Adams, o.b.e., f.z.s., i.a. (Retd.)

Part V—Bears

(With two plates)

In previous sections I have endeavoured to describe jungle episodes not only for their interest, but also to point the moral. My experiences with bears, however, are so limited, that I can do little more than describe incidents as they happened, and must leave it to the reader to extract, if he can, any information which may be of use to him.

I remember very well how, many years ago, I was showing my shikar photos to my aunt's head-keeper in Perthshire, as fine a type of sportsman as one could meet anywhere. He was obviously interested in the prints of tiger, panther and elephant, but what impressed him more than anything was a photo of a bear—a beast he said that he definitely would not like to meet. I suppose it was some subconscious memory of the days when bears were found in Scotland, but it struck me as rather remarkable, for I think most sportsmen in India have a sort of amused contempt for a bear, and until they strike trouble, are not inclined to take them very seriously. That certainly was my own outlook, until a certain episode caused me to some extent to modify my views.

Himalayan Bears

When I came out to India in 1904 my first station was Dalhousie in Chamba State and in those days Red bears were comparatively common. But of course it was impossible for a newly-joined subaltern to obtain leave long enough to try for them, and as my subsequent service was spent in South India, Burma and overseas, I have never yet had an opportunity of bagging one. All I could manage was to slip away on Sundays to try for the Black bears which used to raid the fields not far from the station, so my shikari assured me, and I think he was probably right, though I was far too inexperienced to be able to judge correctly. Often I spent a moonlight night trying to intercept a crop-raider, but never saw one, though I was shown fresh tracks reputed to be bears. So it happened that I did not meet a Himalayan bear till years later, and then it was in Burma.

That was in 1913 at Magyigon, while I was searching for the wounded rogue elephant as already described in a previous section. We were going along in the jungle looking for tracks, when I saw a bear asleep in the fork of a tree, a good 30 feet up and some 50 yards in front of us. I fired a conical bullet from the left barrel of my 10 bore (if the right was fired first both barrels used to go off together), and down the perpendicular trunk came the bear like a flash—I think she must have fallen most of the way. The roars got fainter and I thought she had gone some way, but really she was lying dead at the foot of the tree. I had no tape with me, and as we had to take the skin off at once I was unable to take measurements, but the dried skin in a photo shows that she was a very large beast, and my diary says very fat too—gallons of it. Unfortunately this fat made it impossible to dry the skin satisfactorily under monsoon conditions, and it proved rotten when sent to the taxidermist, in spite of every attention and frequent scraping. Probably I should have done better to salt it and keep wet in brine—one lives and learns!

A Lucky Mistake

In the course of many years of shikar one inevitably has a number of lucky shots, but the most extraordinary I ever made was in Burma in 1920. I had got week-end leave from Meiktila and was trying for tsine near Yinmabin on the Kalaw ghat. We had been out from dawn but could not find fresh tracks till too late to be of use, so had to give it up till the afternoon. On our way back we came across very fresh bear droppings, and my *mokso* Ko Po said it was probably lying up in a thickly bushed nulla close at hand. Cautiously working along it I suddenly saw a black mass moving in the dense cover on the opposite bank about 40 yards away, so thinking it was the bear I fired for the shoulder, and brought it down. Ko Po, who was literally dancing with delight shouted out. 'You have got them both', and when I asked what he meant he said it was a couple of pigs! And so it was—they had been moving side by side on the sloping ground, one slightly in advance, and my bullet had taken the top off the head of the lower one and then passed through the heart of its companion. No wonder the *mokso* was pleased, as they were a couple of huge sows, and he anticipated selling the meat for upwards of Rs. 100.

That a bullet should pass through the animal aimed at and wound another beyond, must be within the experience of many sportsmen. Only a few years ago a case occurred at Mudumalai where a spotted stag was shot, and the bullet wounded a doe and fawn standing beyond; but the extraordinary point in the case I have related is that both animals were killed dead with a single shot. I am afraid some readers will doubt my veracity, but I can assure them that the incident did occur exactly as described. Of course it was a most amazing fluke, but at the same time it is an unforgettable jungle memory.

MALAYAN BEAR

It was while I was stationed at Bhamo in Upper Burma that I bagged the only Malay bear which I have seen. This must have been in July 1914 (my diary of the period is very condensed and omits dates), as I had my Chinese *munshi,* Hwan Jhi Lieng with me, and I know that I passed my examination in Yunnanese shortly afterwards and before the outbreak of war.

On this particular occasion we went up the Irrawaddy by boat to Thapanbin and beat the jungles on the left bank for anything which might turn up. In the first beat a sambar cantered past me at 90 yards and I got it with a lucky shot from my No. 2 Express—the Burmans would not believe I had hit it till I showed it lying dead. Two beats later I was watching with some amusement my little Chinese *munshi* as he tried to draw a bead on a sambar passing him, when suddenly a Malay bear came out in front of me. My right barrel missed fire, but the left rolled him over and another shot finished him. The skin was a very fine one with short thick glossy fur and a wide orange V, but unfortunately three days' heavy rain prevented my saving it, and now I have not even the skull to remind me of the affair. What pleased my Burmans most was that he was full of honey, which ran out of his mouth all the way back to camp—those who know Burma will realise that it was not wasted!

What happy care-free days those were before two World Wars upset everything, and what cheerful and willing helpers the Burmese villagers were, if one could speak their language. Never shall I forget another trip to Thapanbin when, after beating the jungles across the Irrawaddy, we had to return in a violent thunderstorm. There were some 30 of us in a Burmese racing boat with only 2 inches of free-board, and the water was very rough, but I think I was the only one who worried at all!

SLOTH BEAR

When I first visited Chanda in the Central Provinces in 1906, sloth bears were very common, and since a number of villagers had been mauled, Government paid a reward of Rs. 5 on each skin brought in. It was here that I bagged my first, a large female which we suddenly came across standing up and eating out of her paws, which were full of white ants. She was off before I could shoot, but rushing after her I found her lying under a thick bush with her paws over her face. A soft-nosed bullet from my Jeffery .400 roused her and she bolted into some thick cover, where a few seconds later we heard her 'yodel'. Cautiously approaching I gave her another shot but it was unnecessary.

The timid behaviour of this bear was in marked contrast with that of another which I encountered in the following year. At the time I was in camp at Soorsa near Moharli, and during our first night there two bears were either fighting or making love close by—the noise was a '*whoo-hoo*' like a child crying and suddenly bursting into violent sobs. Next day we heard them at it again some miles away while working the jungle, but could not contact.

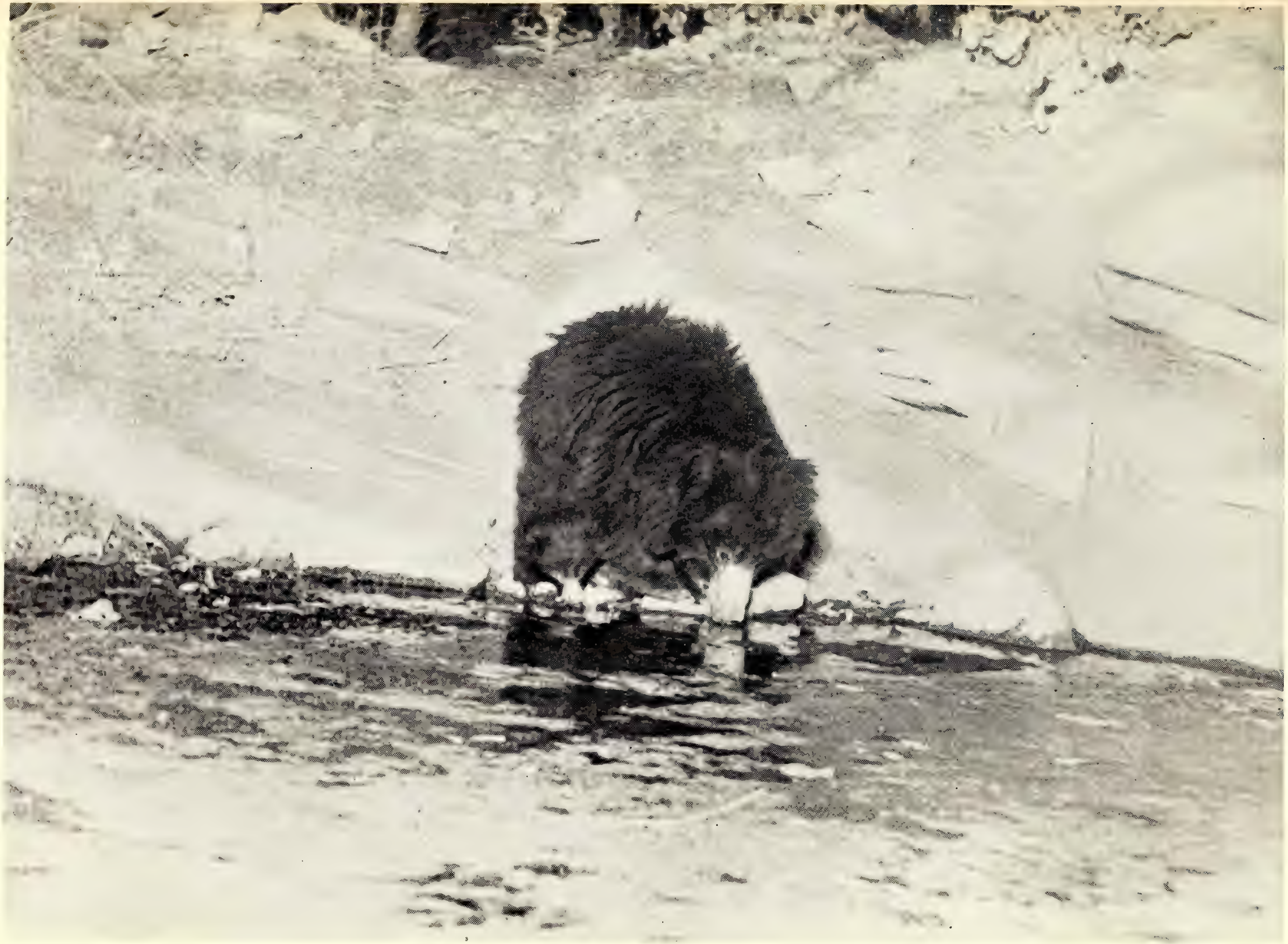
They returned close to camp that night, the attraction no doubt being our water supply, as there was little available elsewhere. On the following morning I started off at 4.30 a.m. for distant bison ground, and at 5.15 suddenly heard a grunting noise quite close behind us. I thought it was a pig but the shikari said it was a bear, and I had scarcely time to change rifles when he was charging downhill at us making a most disgusting uproar. It was of course too dark to see the sights, so I decided to reserve my fire till he was close on us. He was going so fast that almost at once he was within 5 yards when I fired both barrels of my No. 2 Express in rapid succession. The flashes lit up the whole scene as he reared up and fell over sideways and backwards, leaving a picture of claws and black hair, but above all of the big white V which showed up very clearly. The shikari had bolted and got up a tree, but my orderly stood like a rock, and just before I fired I heard him click down the safety catch of the .303. The bear went off slowly but it was too dark to follow, so I left that till we returned the same way at 9 a.m. We then found that both bullets had hit and that there was a heavy blood trail which we followed some way till it led into such bad ground that we had to give it up. I sat up over the nearest waterhole that night but he never came to it, and I think he must have died not far from the scene of the encounter. This was one of the closest calls I have had in the jungle, and shows how aggressive a bear can be at times, though without the slightest provocation.

BOMBING CAVES

As a rule bears feed at night and lie up in caves during the daytime, and if one can get a shot as the animal returns at or soon after dawn, well and good. Otherwise it may be possible to smoke it out, though in my own experience this method seldom produces results.

While I was at the School of Musketry, Satara, in 1908, a friend and I managed to get week-end leave, and went out to prospect some ground reported to hold bears about 25 miles away. Before dawn next day I put T. to sit up over a cave where there were fresh tracks, while I went off to wander through the jungle. The bear came alright and obligingly stopped at the mouth of the cave to sniff at a ginger biscuit which T. had inadvertently dropped—he fired but missed, though not more than 20 feet above. I heard the shot so returned, and after we had had breakfast, decided to smoke the bear out. We made a huge fire of grass and green brushwood at the mouth of the cave, with chillies added to give it pungency, but though we kept at it from 10 a.m. to 1 p.m., we were unable to move the animal and had to give it up as a bad job.

No doubt that cave went too far into the hill for the smoke, or the fireworks which we subsequently tried, to have any effect, but when caves are shallow it is possible to bomb them out. While I was on recruiting duty in 1915 I camped for some days at Kangundi, a small raj in the N. Arcot district, where I was anxious to establish a recruiting connection. The local men were keen on shikar, so I thought it would help matters if we had a bear hunt, and a fine chase one gave me! The whole country there is a mass of small hills



Flashlight photo

H. H. Maharao of Kotah

A sloth bear at a waterhole.

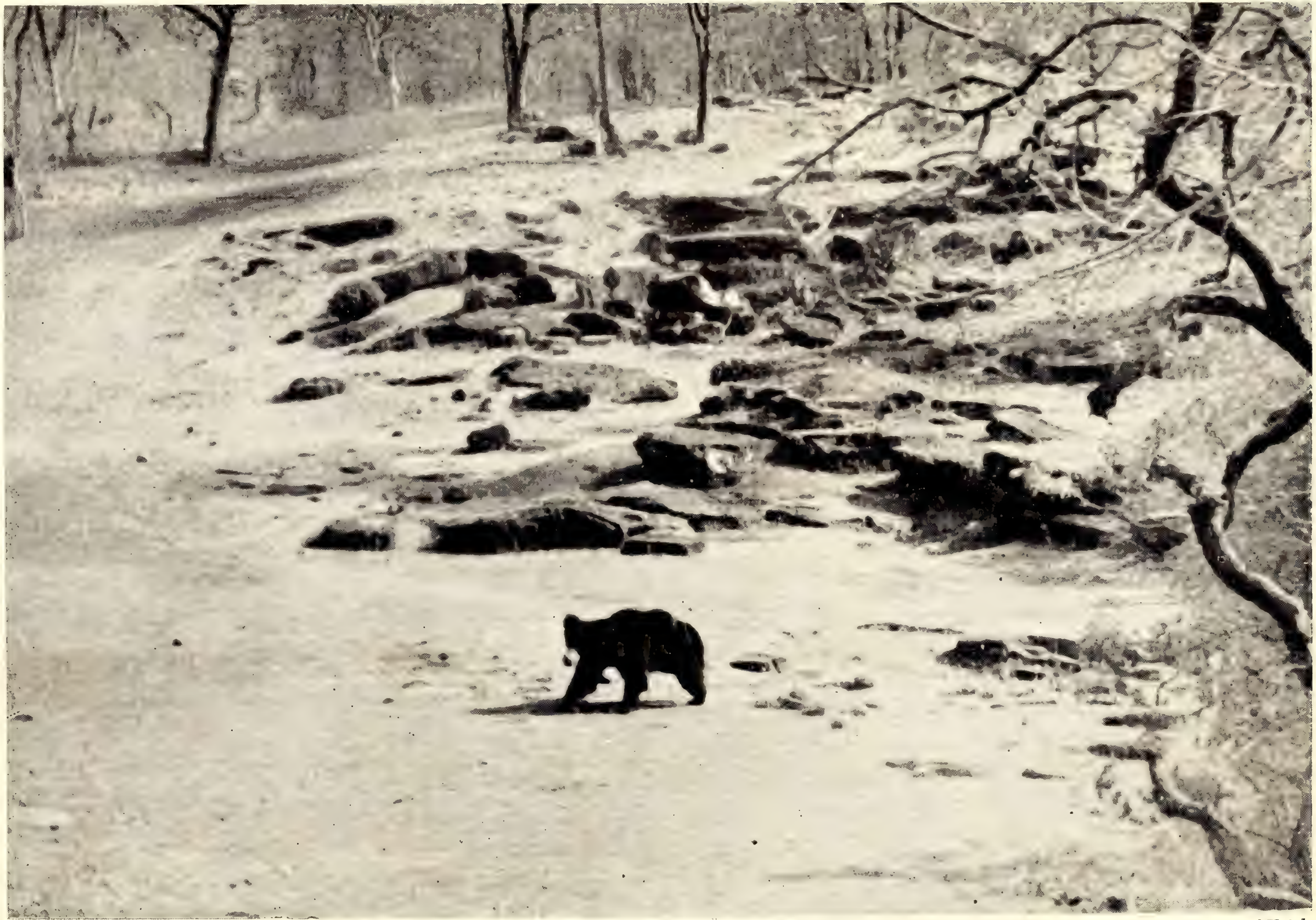


Photo H. H. Maharao of Kotah

A sloth bear returning from the night's foraging.

covered with jungle, and with caves everywhere. An old bear was located on the afternoon of 30th May, so I started after him next morning, but found he had got into a cave. I took an uphill position, but when bombed out he bolted down and gave no shot. Next beat, positions were reversed and he bolted up while I was below—incidentally he nearly caught the shikari. We followed him across a plateau and half-way down the other side, and bombed him out of his third cave. This time he broke past me but gave no shot, and the same thing happened in the following beat. It was now after 1 p.m. and I was nearly done with the heat, but the beaters were very keen on one more attempt, so I agreed. My post was on a rock downhill and when the bear was bombed out of his refuge (an open cave), he came past me along the hill-side about 50 yards away. I was using my 12 bore with 'Destructor' bullets and aimed for his shoulder, but he stopped as I fired, and took it in the neck instead. He proved to be a very fine old bear with a huge head and worn teeth, and we carried him up to the cave he had just vacated and had a long rest there before starting back. We got the bear to camp by 5 p.m., and I presented a haunch to the Dowager Rani at her request. In return she sent a troupe of dancing girls to celebrate my success—some of them were quite attractive, but my orderly whispered to me that all were boys! However that may be, they certainly put up a good show, and their graceful movements provided a pleasant climax to a very arduous day. A heavy thunder storm that night made me wonder whether I should have my usual bad luck with the skin, but treatment on both sides with Taxinine powder prevented the hair slipping, and luckily I was able to get it in next morning to a taxidermist in Bangalore who made an excellent job of it.

NILGIRIS

Seventy or eighty years ago bears were quite common on the plateau, and old shikar books record their being shot in the grounds of Government House at Ootacamund. But those days are gone, never to return, and nowadays the only bears which remain on the Nilgiris are found in the low country, in the Anaikatti and Mudumalai forest reserves. Even there they are few and far between, and since their habits are largely nocturnal it is seldom that one is encountered. In the past 24 years I have fired at only 4, and perhaps the incidents are of sufficient interest to merit inclusion in this series.

In February 1929 I went into camp at Anaikatti to try for a very fine bison reported to be in the vicinity. At 2 p.m. on the afternoon of our arrival, from the verandah of the bungalow, I spotted a fine black bull crossing the spur to the east of the Honey Rock, some 1½ miles distant, so went after him. When we reached the spot we found a herd, and as the bull, though a grand animal, was not the one I wanted, we sat down and watched them for some time, and then started back about 5.30 p.m. We soon came across fresh traces of bear, and shortly after, while passing below a small cliff face, heard subdued growls in front. The noise was only some 10 yards away, but to get a view into the cave was impossible owing to the slope of the ground, unless one crept round the corner to the mouth of it, which was asking for trouble on so steep a slope. We withdrew and tried to look in from the top, but it overhung so that we could see nothing. As no alternative offered we then returned to our original position, and my shikari Kala threw a couple of stones round the corner without effect. I was wondering what to do next, when with angry growls a black ball rushed out in front of me and disappeared in the long grass downhill. I had no time for a shot, but before I could lower my rifle, another followed. A quick snap-shot hit, and the bear turned offering his side at not more than 40 yards. I could see only his upper half above the grass, but a shot at the shoulder knocked him over, and after floundering about he disappeared from sight. Shortly after we heard the death wail some way below and found that he had rolled a considerable distance down the very steep slope. My shikari said there was probably a third animal, as three bears had on several recent occasions chased villagers below the Succoth Estate not far away. I thought it unlikely after the firing, but went and examined the cave—it was only a sheltered overhang of rock with no depth and obviously empty. We then went down to examine the one shot and found it to be a young but full grown male—the pads of the fore-paws were badly abraded—one had maggots in it and the other an ingrowing claw, which cannot have improved his temper. The first bullet (soft nosed .423 Mauser) we found had broken the bear's left shoulder, and the second his right and carried broken bits of bone through the heart, a shot which I have found far more effective than if placed *behind* the shoulder when the animal is broadside on. This point has already been referred to in the article on tigers.

Three days later I beat the big ravine two miles east of the forest bungalow, as there were numerous fresh bear tracks in that direction, and a lot of open caves which could be easily bombed. The second beat held a bear but it broke out to one side and offered no shot, so I moved about a mile upstream. About 2.45 p.m. I got into position on a huge rock covering the bed of the ravine some 50 feet below me, and also the opposite bank so far as intervening trees and bushes permitted—my shikari Kala was up the slope behind me as stop. About 3 p.m. the beat was audible in the distance, and shortly after I heard Kala shouting and throwing stones, which were answered by the angry grunts of a bear. Standing up and turning round to command the slope behind me, I saw a bear about 35 yards away, evidently annoyed that its attempt to break out had been frustrated—its ears were laid back, making its head look very well brushed and smooth. I fired at once for the shoulder; and after carrying on for 20 yards or so it went out of sight behind a bush, and gave the death wail. When the beaters came up, I had a little fun with them, saying that I had shot a large monkey, and it was most amusing to see how their long faces brightened up when they saw what it really was. It proved to be a female, and was probably the companion of the one shot previously—this one also had a raw patch on one fore-paw and only 3 claws, of which 2 had grown in circles but without entering the foot. I noticed that the pads of both bears were well stained with the juice of prickly-pear fruit. Huge areas were covered with the latter in those days and bears were then common, but since the unfortunate introduction of the cochineal insect and the consequent elimination of most of the prickly-pear, bears are now seldom to be found in that locality, and there has been a very marked diminution in peafowl and junglefowl, which also are so fond of that fruit.

I have fired at only 2 other bears at Anaikatti since then. The first of these was at Xmas 1936 when, going along a jungle path on a cold misty morning soon after dawn, we spotted a bear grubbing about in a thicket only 45 yards away. The light was so bad that it was difficult to make out, but when it reached an opening in the bushes I had a steady shot. I was surprised to see it go off apparently untouched as I felt sure I had hit it, so ran after it, but the bear, whose progress had till then been fairly leisurely, soon got into top gear and left me winded. I then went back to the thicket to look for blood, and found that my bullet had hit a twig about an inch thick and had been deflected. He was a fine big brute and it was hard luck to lose him like that.

The last bear I have met was when after small game early in 1948, some 6 miles downstream from Anaikatti. We were beating a long ravine thickly covered with bushes and scrub, and I heard the men shouting that a bear was coming towards us. At Anaikatti it is as well always to carry a few ball and buckshot cartridges, as one never knows what will turn up. I therefore reloaded with those, and shortly afterwards heard the bear grunting as it tried to break past the stops on my left. There was a small game-path leading out of the bushes 11 yards in front of me and the bear suddenly appeared there, but stopped on seeing me. Though at such close range it was very hard to make him out in the thick cover, but it was obviously necessary to fire at once, and I did so, aiming for his throat. The bullet turned him, and as he went off, I gave him the left barrel at the back of the head, but neither shot seemed to have much effect, and a minute later he bolted past the gun on my right, who got in two useful shots in the open. That, I am sorry to say, was the last we saw of him, for though we followed the blood trail some way, we never came up with him. Bears are extraordinarily tough animals and unless the bullet is very accurately placed (not too easy on account of their long hair) the chances are they will get away.

Talking of their long hair, I am surprised that so many shikar books refer to it as more suited to Arctic conditions than to the climate in which they live. But the hair though long is comparatively thin, and can hardly be hot. It seems to me more likely to be a non-conductor of heat, just as those who have served in Iraq will remember how the Arabs during the hot weather are in the habit of donning additional *black* clothing. I imagine the bear's long hair is intended mainly to protect him from bees when he raids the combs, as he is so fond of doing.

BEAR KILLED BY TIGER

From time to time when wandering in the jungle one comes across the scene of a jungle tragedy. In 1908 I was shooting in the Kauria Zemindari of the Raipur district, C.P., and one afternoon having nothing better to do, as I was tying up for tiger, I climbed the big 800 foot hill above my camp. In a hollow at the top we found the skeleton of a bear which had obviously been killed by a tigress a few days before, as it was comparatively fresh. The place showed signs of the conflict quite clearly—tufts of hair were lying about and a mass of pug marks of both the tigress and the bear showed beyond doubt what had happened. It also explained why the tigress refused to take any of the baits I was tying out for her. She could hardly have come out of the fight altogether unscathed, and had presumably moved to other quarters.

SALLY

It was while I was at Bhamo in 1915, after my return from recruiting duty, that a Burman one day brought in to the fort a couple of very small Himalayan bear cubs. I bought one of them and a brother officer the other, for the small sum of Rs. 5 each if I remember rightly. Sally and George, as we named them, were a source of endless amusement. They were tied up to adjacent posts on the verandah of our quarters, and I remember we found it necessary to shorten their chains, after we had returned one morning from parade, and found that Sally had got several turns of it round George's neck and was, no doubt unintentionally, strangling her brother. One very peculiar habit they had of putting their paws over their faces and inhaling deeply when having an easy after their evening meal. Exactly why they did this we could never discover—they were not sucking or licking their paws so far as we could see. Every now and then one would get loose and make for the nearest tree, and sometimes it would be hours before we could get it down.

George unfortunately did not survive long, but Sally throve apace and was quite a big girl when the regiment moved to India. She took the river steamer and the sea voyage as a matter of course, and was perfectly happy so long as she was with the men, with whom she was a great favourite. Within 48 hours of our arrival at St. Thomas' Mount, we received a signal to mobilise on field service scale and re-embark at Madras by 1 p.m. on the following day. We did it too, with 5 minutes in hand, but I had to leave Sally behind with my orderly, who had charge of my bungalow. And it was while I was away that on one occasion she caused some 'alarm and despondency', to a worthy padre who after dining well, took a short cut to his bungalow through my compound, in the early hours of the morning. Hearing footsteps, Sally came out from behind her tree and waddled towards him, no doubt with the most friendly intentions, but it gave the padre the shock of his life!

I then went off to a Staff job and when the regiment proceeded to Mesopotamia in 1916, joined it en route, so had no chance of seeing Sally again. She was left with the depot at Secunderabad, and though full grown was entirely without vice. A playful habit of hers was to sit up as one approached and deliver a round-arm swing, and unfortunately this proved her undoing, as one morning her claws caught in the C.O.'s breeches and removed most of them—so she departed to the zoo. When I returned from Mesopotamia I tried to find her, but was unsuccessful, so all that remains to me of Sally is her photo and a very happy memory, though perhaps hardly a jungle one.

(*To be continued*)

SOME NOTES ON THE GENUS *PHYLLOSCOPUS* IN KASHMIR

BY

HORACE G. ALEXANDER

I was in the Liddar Valley, Kashmir, from June 12th to July 4th, 1949, with Pahlgam (7,000 feet above sea-level) as base. All my observations were made between that height and 10,000 feet, apart from brief excursions higher and lower.

The phylloscopi have always interested me, and I have spent many hours standing trying to get satisfactory views of these tiny birds as they flit about in trees or bushes, and much oftener failing than succeeding. The notes that follow must only be regarded as a first essay (as far as I am concerned at least) on Kashmir phylloscopi. It will be seen that I am by no means clear about the status, even in this limited area, of several species. Ticehurst, in his excellent monograph of the genus, warns his readers against field identifications. This warning should be taken to heart, and the field observer should always either present his evidence for identifications, or should only give his identifications as tentative. On the other hand, the observer today has the inestimable advantage of Ticehurst's book to help him. I never go on a holiday in India without it, and even when I leave it behind when out on a day or two's trek, I generally regret its absence.

In what follows, I try to deal with the species observed in order of their size, beginning with the largest. In general it may be said that the main divisions of the genus, from the point of view of the field observer, are four: first, large or long-tailed species with no wing-bar; secondly, large species with a wing-bar; thirdly, small or short-tailed species with no wing-bar; fourthly, small species with a wing-bar or wing-bars. All four types are represented in Kashmir. I do not follow the sub-divisions in the above order in what follows. The three long-tailed species with no wing-bar are all smaller than the two with wing-bars, so I take the latter first. On the other hand, the only small species without a wing-bar is slightly larger than those with wing-bars, so here I take it first.

Phylloscopus magnirostris.

This species, the largest of all Indian phylloscopi, is common in the Liddar Valley. Once you have learnt its very distinctive song, which apparently is hardly subject to any variation, its presence is easily detected. The song is a clear bell-like cadence of five notes: '*twee—ti-ti tu-tu*'. The call-note is of the same character, a double note, the second note much higher than the first. I noted between forty or fifty of them, nearly always close to running water. It is a strictly arboreal bird. I think I only three times saw one come down to within ten feet of the ground, and I never got wholly satisfactory views of them. The rather broad and dark bill is a useful character. There is one pale wing-bar at the tips of the wing-coverts, but it is difficult to see.

Phylloscopus occipitalis.

This is by far the commonest species of the genus in Kashmir indeed, I think it is the commonest bird of any kind in the Liddar Valley. It occurs from 6,000 feet upwards, wherever there are trees. Its various songs and call-notes seem to form almost exactly the same repertoire as that possessed by the European Coal Tit, but I fear that may not be much help to Indian ornithologists. The commonest of these notes, apparently the song, is a constantly repeated, cheerful, rapid, *chi-wee, chi-wee,* etc. Sometimes it is reversed, with the emphasis on the *wee*: *wee-chi, wee-chi,* etc. This species has one or two fairly distinct wing-bars, but it is the markings on its head that are diagnostic. The dark bands above the eye-stripe and through the eye are often very strongly marked, contrasting with the long yellowish eye-stripe between them. The usual English name for the bird, 'Crowned Willow-Warbler', is given it because of the pale coronal streak, greeny-yellow, somewhat variable in intensity, running from the bill over the top of the head to the nape. Another good field character is the orange base of the bill. This feature, adjoining the beginning of the yellow superciliary stripe, and a yellowish throat, gives the bird a decidedly yellow appearance about the face, in marked contrast to the last species.

Phylloscopus tytleri.

This bird is somewhat smaller than the last two, but it belongs, with them, to the species having reasonably long tails. It has no wing-bar. I only saw a few, and it was some time before I identified them satisfactorily, as they were browner than I had expected. Indeed, I think the field observer may be pardoned for thinking, when he first sees them in Kashmir, that he is watching a Siberian Chiffchaff. The first that I saw at close quarters, in low bushes, was carrying food, so it may have had a nest nearby. I only once heard the song: *whittle-di-wee-you* was the way I syllabified it. After watching several at very close range I described them as rather dull brown all over the upper-parts, the tail showing a trace of rufous or fulvous on the edges of the feathers. The wing-quills seemed to show a very faint trace of greenish, but only very faint. In the hand, the very narrow bill is a good character, but I did not notice this in the birds I saw. Perhaps I should have noticed it with more extensive observation.

Phylloscopus affinis.

On June 30th, in juniper scrub at about 10,000 feet, I saw one of these, and probably a second half a mile from it. It is very easy to identify, being uniform brown above and bright, almost canary, yellow below. At altitudes above 10,000 feet it is probably common.

Phylloscopus griseolus.

On June 18th I saw what appeared to be a bird of this species at the edge of some woodland about 8,500 feet, above Pahlgam. If the identification was correct, it was presumably a bird of passage or a wanderer. It is not difficult to identify, as its upper plumage is a peculiar grey-brown, and its under-parts are oily yellow. It has no wing-bar. In its winter quarters, in Indian jungle, it is fond of hopping about the boles of big trees, and usually keeps near the ground, associating with other small birds.

Phylloscopus neglectus.

This is a short-tailed species without the least trace of a wing-bar. Indeed, I believe it is the only one in the whole genus that combines a short tail with absence of wing-bar. Ticehurst could not trace a single specimen from Kashmir. It appeared to me to be one of the commoner species, so I must present my evidence. On June 22nd and 23rd I came on small parties, the first near Pahlgam not much above 7,000 feet, the second at Lidderwat, at over 9,000 feet. In both cases they were feeding in low scrub near the main Liddar stream, and they were absurdly tame, but extremely skulking, so that I sometimes saw them at barely six feet distance from my eyes, and below me, but only for a split moment, except once or twice when two chased. However, subsequently, on June 28th, 29th and 30th and again on July 3rd, I saw others, latterly singly or in pairs, which were sometimes as polite to the observer as any *Phylloscopus* ever knows how to be. That is to say, I saw individuals at close quarters, below me, which stayed in one spot, in full view, for at least five seconds.

The first I saw were more or less in company with the first *P. tytleri* that I saw, and as both species are brown above and dirty white below without any wing-bar, this caused me some confusion. Happily, this got disentangled later. I had to make up my mind why I was certain that these small brown phylloscopi were not Chiffchaffs. From the first day, my first and most decisive answer was, 'the short tail'. Perhaps it will be sufficient if I quote what I wrote after the final observation on July 3rd. 'My last observation, to-day, is the most satisfactory of all. I was exploring the scrub and boulders of a "marg" about 9,000 feet up, and heard a little three-note song, *ti-wish-i,* in some bushes to my left and below me. Soon I saw a *P. neglectus,* and it was under close observation for the next ten minutes, showing itself on top of bushes from time to time, and sometimes coming within ten feet of me, and all the time below me. It was mostly silent. Then I heard a very faint *peep* behind me, and presently a second bird appeared. The first, in response to the gentle "peeping", came up the hill and fed it, while the second bird shivered its wings. The first then sang several times, there was a little chasing and then they separated again, and I only saw the male. Had the female (for I feel confident it was the mate, not a young bird) come off the nest?—or were they courting? As to colour, I have not much to add [to what I had written in my notes on earlier days.] Plain brown is the colour of the body feathers, from crown to tail. There is no suggestion of a wing-bar. In certain lights the wing-quills and the tail-feathers look slightly fulvous, in others almost olive-green; possibly they reflect a somewhat different colour at different angles. (The birds were seen in bright sunshine at just about noon). The under-parts show no trace of yellow, but are decidedly streaky. I still have no very satisfactory account of the colours of the soft parts. I should say: Eye nearly black, bill brown, legs rather pale brown. The pale superciliary extends a little behind the eye, but is much shorter than in most phylloscopi'.

It will be seen that my evidence suggests that birds of this species were appearing in small parties in the Liddar Valley in mid-June, and beginning to nest there, at heights between 7,000 and 9,000 feet, by the end of the month.

Those in parties were mostly silent, but I occasionally heard a sharp *chip* note, and in chasing one uttered a double *chi-ip*.

Phylloscopus reguloides.

Now we come to what, in Kashmir at least, is the most difficult group, namely the small phylloscopi with wing-bars. Here my information is certainly very incomplete, even for the area in which I was observing. *P. reguloides* is the greenest of this group, its upper plumage appearing a rather bright green, or yellow-green, when it is seen at close quarters. Also, it has a pale occipital streak. I notice that Sálim Ali, in his new book on 'Indian Hill Birds' describes it as the Kashmir Crowned Willow-Warbler. I am afraid this strikes me as an unfortunate name, since the ordinary Crowned Willow-Warbler (*P. occipitalis*) must outnumber it in Kashmir by a hundred to one. But if the word 'Small' were added, it would emphasise the fact that this species, like that, has a pale occipital stripe. This, together with its short tail and greenish upper-parts, should suffice to identify it under favourable conditions. On June 25th I had a close view of one, and a few days later I saw some in a mixed party, but those are all I was sure of, and it appeared to me to be a rather scarce species.

Phylloscopus inornatus humei.

I do not favour the use of trinomials by field observers, as the use of the subspecific name is normally a mere assumption based on what is written in books. It is rarely possible to distinguish one subspecies from another in the field. But in this case, not only is the form of the so-called Yellow-browed Warbler that occurs all over India (except in the extreme north-east) known to be *humei,* but also it is in fact paler and less yellow than *P. i. inornatus,* so that it is not impossible to distinguish. This is alleged to be one of the commoner species in Kashmir at the altitudes I was exploring. My experience suggests otherwise. I only twice heard its very distinctive double call-note, *tiss-yip,* which one can hear almost any day in the gardens of New Delhi in the winter; apart from this I only saw it for certain on two or three occasions in mixed parties of small birds in the woods.

Phylloscopus pulcher.

On June 27th, following a heavy downpour of rain, I found a remarkable concourse of small birds, flycatchers, tits, warblers, etc., in the scrub close to the Forest Rest-House at Pahlgam. Twice, while I stood watching, a bird of this species appeared, its orange wing-bands instantly marking it out. On one, I also caught a glimpse of the white in the tail-feathers, a feature that is hardly found in any other Indian *Phylloscopus,* though it is characteristic of course of the Grey-headed Flycatcher-Warbler, of the nearly related genus *Seicercus.* This bird, by the way, so common at most hill stations in the Himalayas, I did not see in Kashmir.

Phylloscopus proregulus.

This, the smallest Indian *Phylloscopus,* appeared to me to be the most abundant after *P. occipitalis.* Its song is weak, a rapid, rather unmusical, feeble trill, suggesting a *Regulus.* The call-notes I heard included a rather flat *chi-wee,* and, near the nest, a plaintive *twee.* It is readily distinguished by the lemon-yellow coloured rump, often visible when the bird hovers, goldcrest-like, to pic insects off the foliage of the pine trees. When this cannot be seen, the yellowish wing-bars and superciliary streak and occipital streak, the latter rather variable, should help in identification. The general plumage is browner than that of the other small wing-barred phylloscopi of Kashmir.

It must not be forgotten that the Goldcrest, *Regulus cristatus,* is also common in Kashmir. Its general plumage is olive-green. There is a single pale wing-bar and a second pale bar at right angles to it. The occipital stripe is orange or yellow, except in the young birds, which lack this feature. And at the sides of the crown there runs a black line. But below this, the whole face is uniform greenish, with no pale superciliary stripe, and no dark eye-strip, features which are characteristic, in varying degree, of every *Phylloscopus* known to me.

At least four species of *Phylloscopus* may occur at higher elevations in parts of Kashmir which I did not visit. These are *P. collybita lorenzii, P. trochiloides, P. subviridis* and *P. maculipennis.*

A NOTE ON THE RORQUALS (*BALAENOPTERA* SPP.)

BY

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(*With three plates*)

Synopsis

An attempt is made to analyse the published records of rorquals (*Balaenoptera* spp.) stranded on the coasts of India and Ceylon with the object of determining the species occurring in this area. Positive identifications apparently exist for only one species, the Blue Whale, *B. musculus* (Linn.). It seems highly probable, but not certain, that two others, the Fin Whale, *B. physalus* (Linn.), and the Piked Whale, *B. acutorostrata* Lacép., also arrive here at least occasionally. The great majority of the records are merely generic, and to assist in the production of more precise identifications in the future a brief account is given of the external characteristics of the five known living species. The paper finishes with a summary of the records from the Malaysian sub-region, which includes the seas immediately to the east of the northern Indian Ocean.

The Rorquals known from the coasts of India & Ceylon

In a recent number of this journal N. G. pillai (1949: 358) provides an interesting note on an immature rorqual caught alive off the coast of Bombay on 12 April 1949. Unfortunately no specific diagnosis is given. The balance of probability is that the specimen was a Lesser Rorqual, *Balaenoptera acutorostrata* Lacép., but this cannot be regarded as certain on the information available. Similarly, the list of whales stranded on the coasts of India published by S. T. Moses (1947: 377-8) includes only two precise identifications of *Balaenoptera* spp. in a total of more than 25 strandings. The two that Moses cites are an immature Blue Whale, *B. musculus* (Linn.), length about 35 feet, which came ashore at Nirodumunai (Ceylon) in 1932, and a specimen described as '*B. edeni*' which is said to have been stranded in the Sittang estuary in June 1871. *B. edeni* (Anderson, 1878: 551-64) is a synonym of the Piked Whale or Lesser Rorqual, *B. acutorostrata,* but this does not give us a definite record for the latter mammal on the Indian coast as Sittang is situated in Burma, about 75 miles east of Rangoon.

In addition to the Nirodumunai whale cited by Moses, Dr. A. Aiyappan tells me (*in litt.,* 18-3-49) that the Madras Museum contains an entire mounted skeleton of *B. indica* Blyth (= *B. musculus*) which came ashore at Mangalore in 1874. I am also strongly of the opinion that the 61-foot whale figured by Kinnear (in Prater, 1915: 577), which was stranded at Viziadrug near Ratnagiri in August 1912, belonged to this species. No doubt also any of the additional records on Moses's list with lengths of over 80 feet can fairly safely be ascribed to it; these are Quilon 1848, Amherst Island (Arakan = Burma again) 1851, Quilon 1858, near Cherai (Cochin) November

1927, between Suratkal and Moolki 1939, and probably Mulvel (Okhamandal) March 1939. The last of these must be treated with some reserve, as the whale is said to have been 79 feet long but with a flipper length of only 6 feet (see Moses 1941: 896); this is much too short for any rorqual with the body length quoted. Similarly I have not included the 160-foot whale, Pondicherry 1757, cited by Moses from Ananda Ranga Pillay's diary, as the length given is too large for any known species. Even without these last two records, however, we have ample evidence that the Blue Whale, *B. musculus,* does come ashore at intervals on the coasts of India and Ceylon.

There is also, in my opinion, a fairly definite Indian record for the Fin Whale, *B. physalus* (Linn.). This is the 41-foot whale reported by Prater (1915: 576) which was stranded at Dhabool, 97 miles south of Bombay, on 11 December (?) 1913. It is not, seemingly, listed by Moses. Prater identifies it as *B. indica,* but from the description of the colouring and the size of the flippers (measuring 1/9th of the total body length) it must almost certainly have been an example of *physalus.* Probably, though there is no direct evidence to show this, some of the other records attributed non-specifically to 'rorqual' belong to the Fin Whale. The information by which the different *Balaenoptera* spp. can be distinguished from each other is not readily available, but the genus as a whole can be separated from any others occurring in these waters without much difficulty. As a result many identifications have no doubt been left at the level of rorqual on the assumption that that was as far as the matter could be carried.

The rorquals are a group of whalebone whales distinguished from all other members of the sub-order Mystacocœti by a particular combination of a few characters. They have a series of parallel grooves or 'pleats' on the chin, throat and pectoral region, a dorsal fin and fairly short flippers (equal to about 1/7th, or less, of the total length). Taken together, these features are diagnostic of the genus. Five species are known. From the three paragraphs above it would appear that we have undisputed records of only one of these, the Blue Whale, from the coasts of India and Ceylon. On the other hand it is probable that at least two others, the Fin Whale and the Piked Whale, have occurred in our area. Any of the five might reach this region during their wanderings in tropical waters. Even Bryde's Whale, *B. brydei* Olsen, which seemed to Olsen to be confined to the cooler waters off South Africa, from Angola to Natal, has been reported from Granada in the West Indies (Norman and Fraser, 1937: 235). It would accordingly appear to be of general interest to give a summary of the external characters of the known rorquals, in the hope that on future occasions it may be possible to obtain more precise identifications.

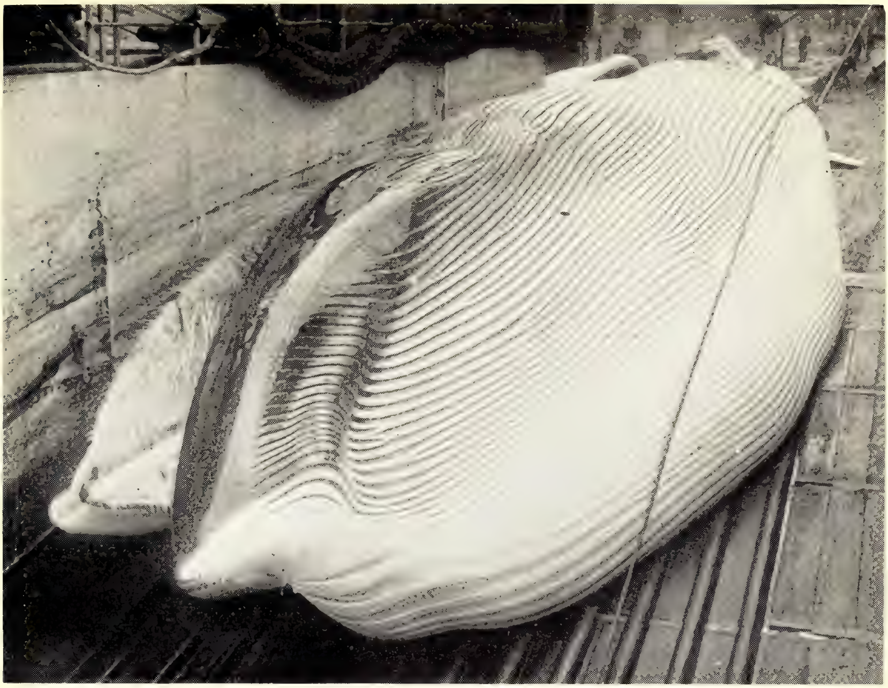
The sizes of the living rorquals can be shown most satisfactorily by the following table, taken partly from Gibson-Hill (1948: 61) and, in the case of the whales of commercial importance, based originally on the 'Discovery' Reports (1929, continuing). The lengths given are measurements in feet from the tip of the snout to the notch of the tail flukes. Oil yields are only very approximate estimates, as there is considerable individual variation: as an example, one might refer, to Olsen's statement (1913: 1079 and 1083) that in Bryde's Whale the yield ranges from 2-3 barrels in an ill-conditioned animal to 15-20 barrels in a very fit one. The highest recorded yield for any species is 305 barrels taken from a Blue Whale flensed at Walvis Bay, South Africa. The measurements of length are as follows:

Species	Approx. length at birth	Average length at sexual maturity		Approx. maximum length	Average oil yield in barrels	Approx. ratio of flipper length to total length
		Male	Female			
B. musculus ...	23	74	77	100	100	1/7
B. physalus ...	21	63	65	82	50	1/9
B. borealis ...	15	44	48	60	17	1/10–1/12
B. brydei ...	? 12	about 30–35		48	8	1/10–1/12
B. acuto-rostrata ...	? 9	about 25–30		33	...	1/8

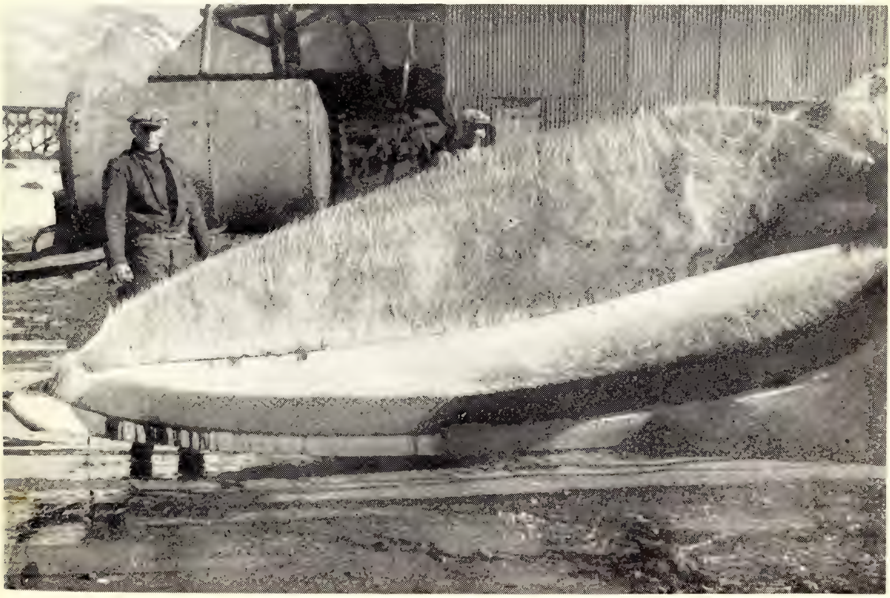
The following are the principal external features distinguishing the five species: the data is taken partly from Norman and Fraser (1937: 218-41) and, in the case of Bryde's Whale, from Olsen (1913: 1073-81). The general colouring and the size and position of the dorsal fin can be used, under favourable conditions, in determining the identity of a rorqual seen at sea. In a stranded specimen attention should also be paid to the grooves on the throat, the size of the flippers and, above all, the form and colouring of the baleen plates. There are also differences in the agility, speed and manner of movement among the larger rorquals at least, but no attempt is made to go into these points here. A certain amount of experience at sea in areas where whales are relatively numerous is essential before the distinctions can be mastered adequately. As in all cases of identifying freely-moving animals, the faculty can only be acquired by practice, and continued practice is needed to maintain it. In the early part of 1946 I was able to separate the three large rorquals at a moderate distance and under reasonable conditions. Now I would not like to attempt to do so. Regular whalers, on the other hand, habitually spot the species and gauge the approximate length, rapidly and surely, except in the case of the Sei and Bryde's Whales, which have even been confused on the flensing platform. Apart from this one instance, no appreciable difficulty is likely to be experienced in identifying a stranded or beached whale, using the points given below. Observers should, however, remember that the body colour, as in man, is affected by post-mortem changes, but there is little immediate alteration in the colouring of the baleen plates.

The Blue Whale or Sibbald's Rorqual *Balaenoptera musculus* (Linn.).

This species has a relatively longer head than other rorquals, with the sides almost parallel for part of their length. The general colouring is a dark slate blue, with the tip and under surface of the flippers whitish; but there is some individual variation in the colour-



An adult Fin Whale, about 70 feet long, being pulled on the deck of a factory ship off the South Shetlands.



Photos *C. A. Gibson-Hill*

The upper jaws and baleen plates of a Fin Whale, about 65 feet long, seen from below.

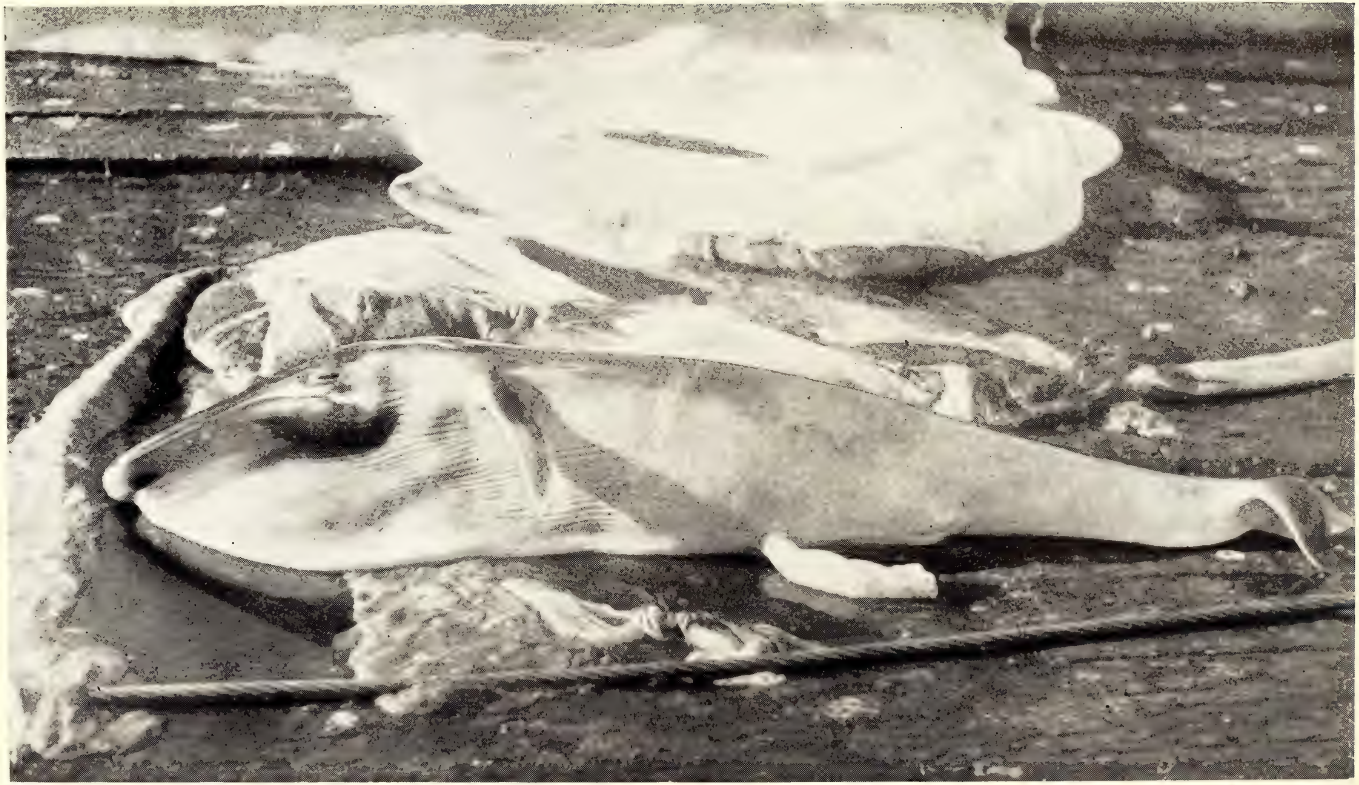


Photo C. A. Gibson-Hill

A fœtal Fin Whale, about 6 feet long, removed from a dead cow on the flensing platform, Leith Harbour, South Georgia.

ing and it may be modified by paler mottling. Whales which have been resident in cold waters for a long period often acquire a covering film of diatoms. This may be so thick as to make the under parts appear glaucous or even yellowish, a feature which has earned for it the alternative name of 'Sulphur-bottom'. The dorsal fin is low, small and placed well back towards the tail. The flippers are long and tapering, measuring about 1/7th of the body-length. There are usually about 80-100 ventral grooves, and in the mid-line they extend back to the umbilicus, about half-way between the planes of the flippers and the dorsal fin. The baleen plates, including the fringes on the frayed inner border, are jet black; this feature is characteristic of the species. The synonyms used in the literature of our area include *sibbaldii* (Gray), *indica* Blyth and 'Great Indian Fin Whale.'

The Fin Whale or Common Rorqual *B. physalus* (Linn.).

The head in this and the next two species appears wedge-shaped when seen from above. The general colour of the Fin Whale is grey above and white below, including the under surface of the flippers and tail flukes, but the pattern is slightly asymmetrical in the region of the head and shoulders. The outer surface of the right lower jaw and the side of the neck is white, while the left lower jaw and adjacent areas of the neck are grey. Inside the mouth the change is reversed, the right side of the lower jaw and the neighbouring part of the tongue are pigmented, while on the left side these areas are without colour. This feature is characteristic of the species. The dorsal fin is fairly tall and triangular in shape, while behind it is a sharp-sided median ridge. The flippers measure only 1/9th of the total bodylength. There are usually about 60-90 ventral grooves, running back to the umbilicus as in the Blue Whale. The baleen plates share the asymmetry of colouring of the jaws. The plates on the right side, for about one-third of the distance back from the tip of the snout, are white; the remainder on that side and all those on the left mandible are a dull blue-grey streaked with pale ash-grey and yellowish grey. The fringes are in all cases yellowish white. The synonyms used in the literature of the Indian Ocean include *australis* (Des.), *blythii* And. and 'Razor-back.'

The Sei Whale or Rudolphi's Rorqual *B. borealis* Less.

The dorsal surface is a bluish black, with the flanks grey and an area on the under surface, stretching back from the chin, white; the extent of this white patch varies to some extent individually, but it never runs as far as the tail and the under surface of the flippers and flukes is always dark. The dorsal fin is relatively larger than in the preceding two species and placed further forward. On the other hand the flippers are still smaller and measure only about 1/10th-1/12th of the total body-length. The ventral grooves range from 36-60 and extend only as far back as a point about midway between the line of the flippers and the umbilicus. The baleen plates are mainly black, with the frayed inner edges white; the latter are quite characteristic, being much longer, softer and silkier than in any of the other rorquals. The synonyms include *schlegelii* (Flower).

Bryde's Whale *B. brydei* (Olsen).

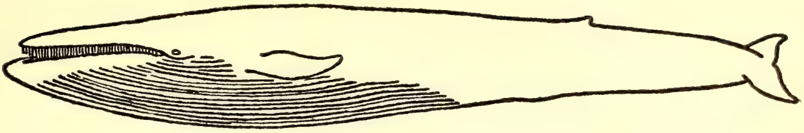
This species is very similar to the Sei Whale, with which it is often confused. The dorsal surface is bluish black, with the chin and throat a dark bluish grey; the under sides of the flippers are grey; the remainder of the lower surface is white or whitish. The dorsal fin is small, and the flippers only about 1/10th-1/12th of the total body-length. The ventral grooves, 42-54 in number extend as far back as the umbilicus, as they do in the Blue and Fin Whales, a point which distinguishes this species from the Sei and Piked Whales. The baleen plates are short, with long stiff bristles; in the anterior part of the jaw they are whitish, sometimes with greyish stripes, while further back they are greyish black. The long stiff bristles on the frayed, internal edges of the plates should be diagnostic of this species. At the present time this whale is known with certainty only from waters off South Africa and off Granada.

The Piked Whale or Lesser Rorqual *B. acutorostrata* Lacép.

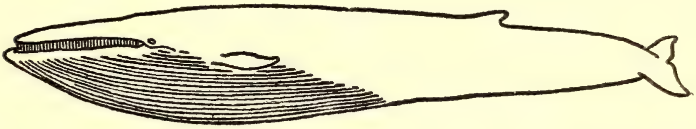
This species has a short head which appears almost triangular when viewed from above. The general colour is blue grey on the upper parts and white underneath, including the under side of the flippers and the tail flukes. There is also a prominent white patch on the outer surface of the flippers, which is characteristic of this species. The dorsal fin is smaller than in the Sei Whale, but it is placed about the same distance forward. The flippers measure roughly $\frac{1}{8}$th of the total body-length. There are about 50 ventral grooves which, again as in the Sei Whale, only extend back to half-way between the flippers and the umbilicus. The baleen plates, including the fringes, are entirely yellowish white. The synonyms include *rostrata* (Müller) and *edeni* And.

Some of the points given above can be tabulated as follows:

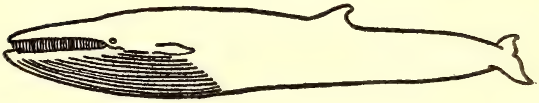
Species	Flippers	Flukes	Baleen Plates
B. musculus	slate-blue above, whitish below.	slate-blue, both surfaces.	jet black, including frayed edge.
B. physalus	grey above, white below		fore part right side white, remainder dull blue-grey.
B. borealis	grey (both surfaces)		black with frayed edge long, fine and whitish.
B. brydei	dark bluish grey above, grey below.	dark bluish grey above, whitish below.	anterior plates whitish, posterior blackish; long stiff bristles.
B. acutorostrata	blue grey with a prominent white patch above, white below.	blue grey above, white below.	yellowish white, including frayed edge.



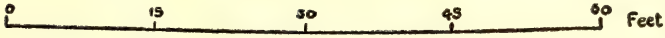
Blue Whale



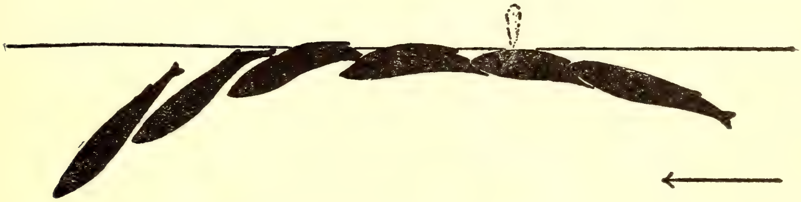
Fin Whale



Sei Whale



Semi-diagrammatic representations of the three larger rorquals, the *Blue Whale*, the *Fin Whale*, and the *Sei Whale.*



Phases in the movements of a large *Blue Whale* coming up to the surface to breathe. The sequence shows the short period during which the back and dorsal fin are exposed, and the manner in which the whale dives again without raising its tail flukes out of the water. The *Humpback Whale* (*Megaptera nodosa*), which also occurs in tropical waters, always throws its tail flukes well in the air as it turns to sound.

It is perhaps of interest to note here that we have only one record of a rorqual from the coasts of the Malay States. This is a suckling Blue Whale, *B. musculus*, about 42 feet long, which was stranded on the beach about 18 miles south of the town of Malacca on the 19th June 1892. The skeleton is at present on exhibition in the Raffles Museum. The only report of the occurrence of the Fin whale, *B. physalus*, in Malaysia is from the south coast of Java, though it is possible that a large rorqual stranded near Lundu, on the coast of Sarawak, towards the end of the last century belonged to this species (see Gibson-Hill, 1950). The Sei Whale, *B. borealis*, is known from Java and the inner Gulf of Siam (ashore at Kandhuli), (Chasen, 1940, 108). Recently, while examining the material in the Sarawak Museum, I found on exhibition there the skeleton of an immature example of this species, approximately 23 feet long. It had come ashore at Pusa, at the mouth of the Saribas River, in January 1909, but no attempt appears to have been made to publish the record.

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BUTTERFLIES OF SIND

BY

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The desert province of Sind, with its scanty rainfall, scorching summer temperatures, hot dry winds and dust, would appear to have little attraction for butterfly life. Nevertheless butterflies are to be found, at times sparsely, but often in large numbers even in such arid and unexpected places as on the stony hills near Tatta, in the sandy wastes of the Thar Desert and along the desolate frontiers of Upper Sind. The number of species is however very limited as this naturally depends on the lepidopterous fauna available. For this reason the Lloyd Barrage and its extensive network of perennial canals which commenced operating in 1932 have up to now had practically no effect on the butterfly life beyond slightly extending the range of a few species, because although hundreds of thousands of acres of rice, cotton, wheat, etc. are cultivated annually in the canal zone such seasonal crops afford little or nothing in the form of food plants for the butterfly larvae. Consequently they have to depend mainly on the natural vegetation of the country, which itself is limited both in extent and variety. The principal larval food plants are thus provided by the babul (*Acacia arabica*), ber (*Zizyphus jujuba*), ak (*Calotropis procera*), kirir (*Capparis decidua*), kandera (*Alhagi camelorum*), khabbar (*Salvadora persica*), and other natural desert vegetation. Larval food plants are also available in the flower gardens of Karachi and in the cultivated citrus groves found scattered about the canal zone. Also by the occasional amaltas (*Cassia fistula*) and *Bauhimia* trees that have been planted at some of the canal inspection bungalows. No provincial list of the butterflies of Sind has previously been published and very little has been written on the subject. In the Sind Natural History Society's journals for October 1935 and 1936 respectively, C. J. Rae has described 'Some Karachi Butterflies' and 'Some common Sind Cold Weather Butterflies', but the main work still remains the 'List of Butterflies from Karachee' by Lt.-Col. Swinhoe, which appeared in the *Proceedings of the Zoological Society* of London, 1884, and which that author subsequently enlarged and rewrote in his article 'On the Lepidoptera of Karachi and its Neighbourhood', published in the *Journal of the Bombay Natural History Society*, Vol. II, No. 4 (October, 1887). In that article Swinhoe mentioned that due to the recent introduction of the Karachi Water Works gardens were springing up everywhere and all kinds of new trees were being cultivated, and he thought it possible that the list of Karachi butterflies might go on increasing every year with the growth of vegetation until it somewhat resembled that of Bombay. It is therefore interesting to note that this increase has not yet materialised and that now, after some 60 years, the list of Karachi species is still very similar to what it was in Swinhoe's days. The following provincial list has been prepared from observations made all over Sind between 1932 and 1947, and for the purpose of this list the Lower-Upper Sind boundary has been taken as an east-west line through the town of Nawabshah. Examples of most species are met with more or less throughout the year, but the best season is from July to November, and butterflies are particularly numerous in the occasional years of heavy summer rain. The notation followed is according to that given by Brigadier W. H. Evans in his 'Identification of Indian Butterflies'.

1. **Tros aristolochiae aristolochiae** F. The Common Rose.

The form *diphilus* Esp. is not rare.
Karachi and Lower Sind. Common. Not noted in Upper Sind.

2. **Papilio polytes romulus** Cr. The Common Mormon.

Swinhoe does not include this in his final list although in his earlier list he had noted it as rare. It is now common in Karachi, rare in Lower Sind and has not yet extended its range north of Nawabshah.

The ♀ forms that occur are *romulus* Cram. and *cyrus* Fabr.

3. **Papilio demoleus demoleus** L. The Lime Butterfly.

Common all the year round. The brownish-yellow insect is also common.[1]

4. **Belenois mesentina mesentina** Cr. The Pioneer.

Common and numerous.

5. **Catopsilia crocale** Cr. The Common Emigrant.

♂ form *alcmeone* (Cram).
♀ form *crocale* (Cram).

The Emigrants are found throughout Sind, their numbers generally depending locally on the presence of amaltas and *Bauhinia* trees, which provide their principal larval food plant. Out of the four species that occur all except *pomona* F. are common.

6. **Catopsilia pomona** F. The Lemon Emigrant.

7. **Catopsilia pyranthe minna** Herbst. The Mottled Emigrant.

8. **Catopsilia florella gnoma** F.[2] The African Emigrant.

9. **Terias laeta laeta** Bdv. The Spotless Grass Yellow.

In his first list of Karachi butterflies Swinhoe has noted this as 'June. Rare', but in his final list states, 'A common insect at Karachi and very plentiful in May and June.' It is now scarce both in Karachi and in the rest of Sind.

10. **Terias hecabe simulata** M. The Common Grass Yellow.

This is the grass yellow met commonly everywhere. In order to ascertain whether *T. h. fimbriata* Wall occurred in Sind a series of grass yellows were taken at various places in different months of the year. All were identified by the B.N.H.S. and confirmed by Brig. Evans as *simulata*.

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[1] In the experience of Mr. M. A. Wynter-Blyth these brownish-yellow insects are old examples whose coloration has been faded by the elements.—EDS.

[2] Nos. 7 and 8 are now considered the wet season form and dry season form respectively of the same species. M.A.W-B.

[11. **Ixias pyrene satadra** M. The Indian Orange-tip.

This is shown in the Identification of Indian Butterflies as occurring in Sind. Swinhoe does not record this insect nor did I ever come across it.]

12. **Colotis amata amata** F. The Small Salmon Arab.

The colotis group (except *protractus* and *fausta*) are found everywhere and are the commonest butterflies in the Province.

13. **Colotis protractus** But. The Blue Spotted Arab.

Locally common throughout Sind.

14. **Colotis vestalis** But. The White Arab.

15. **Colotis fausta fausta** Oliv. The Large Salmon Arab.

Taken near Karachi, Dabeji, Oderolal and Sukkur. Rare.

16. **Colotis etrida etrida** Bdv. The Little Orange-tip.

17. **Colotis danae dulcis** But. The Crismon-tip.

18. **Danais limniace mutina** Fruh. The Blue Tiger.

Common in Karachi in July and August after rains. Scarce in the rest of Sind.

19. **Danais plexippus** L. The Common Tiger.

Occurs only in years of heavy rainfall. Entirely absent from 1938 onwards and then appeared in large numbers in Karachi from July to September, 1944, after abnormal rains.

20. **Danais chrysippus** L. The Plain Tiger.

One of the commonest butterflies in Sind, seen everywhere and in every month of the year. v. *alcippoides* M. and v. *dorippus* Cr. both occur.

21. **Melanitis leda ismene** Cr. The Common Evening Brown.

Karachi. Very rare. Swinhoe took one in 1879 and two in 1886.

22. **Ypthima asterope mahratta** M. The Common Threering.

Karachi. Very rare. Swinhoe records taking one in 1886. I did not come across this insect or *M. l. ismene* although constantly on the lookout during the past 15 years.

23. **Hypolimnas bolina** L. The Great Eggfly.

Karachi. Very rare. Swinhoe notes 2 specimens in 1882 and 2 in 1886. This insect and the two listed above now appear to be extinct.

24. **Hypolimnas misippus** L. The Danaid Eggfly.

Common in Karachi after heavy rain from July to December. Not common in Lower Sind. Not noted in Upper Sind.

25. **Precis hierta hierta** F. The Yellow Pansy.

The Yellow, Blue, and Peacock Pansies are common in most months of the year.

26. **Precis orithya swinhoei** But. The Blue Pansy.

27. **Precis lemonias vaisya** Fruh. The Lemon Pansy.

Swinhoe took one in 1885 at Karachi.

In 1936 not uncommon near Jacobabad, but elsewhere in Sind I came across none until I took one in Karachi in 1942. Suddenly became numerous throughout Sind from October to December 1943. After 1944 became occasional in Karachi and Lower Sind and was not seen again in Upper Sind.

28. **Precis almana almana** L. The Peacock Pansy.

29. **Vanessa cardui** L. The Painted Lady.

Common. Often numerous.

30. **Atella phalanta** Drury. The Common Leopard.

Karachi only. Very rare. Swinhoe took one in July, 1882, and I took one in Sept. 1942.

31. **Tarucus callinara** But. The Spotted Pierrot.

The blue pierrots are found in most months of the year. 34 specimens taken in the Hyderabad and Karachi Districts between Sept. 1938 and June 1939, were identified by Brigadier Evans, through A. Jones, as follows: *callinara* 5, *nigra* 21, *alteratus* 6, *nara* 1, *theophrastus indica* 1.

32. **Tarucus theoprastus indica.** The Pointed Pierrot.

33. **Tarucus extricatus** But. The Rounded Pierrot.

34. **Tarucus alteratus** M. The Rusty Pierrot.

35. **Tarucus nigra** BB. The Spotted Pierrot.

36. **Tarucus nara** Koll. The Striped Pierrot.

37. **Syntarucus plinius** F. The Zebra Blue.

August to November. Not common.

38. **Azanus ubaldus** Cr. The Bright Babul Blue.

Very numerous around babul trees from June to November.

39. **Azanus uranus** But. The Dull Babul Blue.

Is greatly outnumbered by *A. ubaldus*.

40. **Zizeeria trochilus trochilus** Freyer. The Grass Jewel.

41. **Zizeeria trochilus putli**[1] Koll. The Grass Jewel.

The two Grass Jewels are found in the vicinity of Karachi, generally in the grasses along the coastline.

42. **Zizeeria lysimon** Hub. The Dark Grass Blue.

Very common all the year round.

43. **Euchrysops contracta contracta** But. The Small Cupid.

Very common in all months of the year.

44. **Euchrysops pandava minuta.** The Plains Cupid.

Scarce. Possibly often overlooked. Several taken in Nov. and Dec. 1943 near Umerkot.

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[1] Mr. M. A. Wynter-Blyth questions this record since this is a South Indian butterfly.—EDS.

45. **Catachrysops strabo** F. The Forget-me-not.

Locally common Nov. to March.

46. **Lampides boeticus** L. The Peablue.

Common.

47. **Apharitis acamas hypargyrus** But. The Tawny Silverline.

Small broods met occasionally. Rare.

48. **Spindasis elima elima** M. The Scarce Shot Silverline.

Not observed by me, but Swinhoe states 'Several taken in the Hubb River by Capt. Becher in Sept. 1885.'

49. **Virachola isocrates** F. The Common Guava Blue.

Karachi. Rare. Rae found it in one particular orchard in Karachi in 1935 and I took it in June, 1944.

50. **Hasora alexis alexis** F. The Common Banded Awl.

Karachi. Very rare. Swinhoe records one in July 1882 and I noted one in July 1944 after abnormal rains.

51. **Badamia exclamationis** Fab. The Brown Awl.

Karachi. Very rare. July 1944, and one in June 1885 by Swinhoe.

52. **Gomalia elma litoralis** Swin. The African Marbled Skipper.

Karachi. Recorded in July 1879 by Swinhoe.

53. **Syrichtus galba** F. The Indian Skipper.

Found locally throughout Sind. Not common.

54. **Syrichtus evanidus** But. The Sind Skipper.

Rare.

55. **Suastus gremius gremius** F. The Indian Palm Bob.

Very rare. A few taken in Karachi in Sept. and Oct. 1943.

56. **Baoris mathias mathias** F. The Small Branded Swift.

This and *B. m. thrax* (below) are common in all seasons.

57. **Baoris mathias thrax** Hub.

58. **Baoris bevani bevani** M. Bevan's Swift.

Karachi. Recorded in Oct. 1885 and July 1887 by Swinhoe.

59. **Gegenes nostrodamus karsana** M. The Dingy Swift.

Not rare but often overlooked.

NOTES ON THE SCROPHULARIACEAE OF BOMBAY

BY

H. SANTAPAU, S.J., F.L.S.

VERBASCUM Linn.

Verbascum coromandelianum (Vahl) Kuntze ('coromandelicum'), Rev. Gen. Pl. 1: 468, 1891; Pennell, Scroph. West. Himal. 39, 1943.

Celsia coromandeliana Vahl, Symb. Bot. 3: 79, 1794; Roxb., Fl. Ind. 3: 100, 1832; Nees in Trans. Linn. Soc. 17: 80, 1837; Benth. in DC. Prodr. 10: 246, 1846; Hook. f., Fl. Brit. Ind. 4: 251, 1883; Dalz. & Gibs., Bomb. Fl. 176; Wight, Icon. t. 1406; Cooke, Fl. Pres. Bomb. 2: 281; Gamble, Fl. Madr. 945; Murbeck, Monogr. Gatt. Celsia 130, 1925.

Celsia viscosa Roth, Catal. Bot. 2: 69, 1800; Wight in Hook. Journ. Bot. 1: 228, 1834; Nees, loc. cit., 81; Don, Gen. Syst. 4: 499, 1837.

Verbascum celsoides Benth, loc. cit., 229; Hook. f., Fl. Brit. Ind. 4: 250, 1883.

'By Linnaeus these two genera (*Verbascum* and *Celsia*) were placed in different classes, *Verbascum* in Pentandria, with five stamens, and *Celsia* in Didynamia, with four stamens in two pairs . . . Linnaeus concluded his account of *Celsia* with the comment that his adduced characters show how well it differs from *Verbascum,* an acknowledgement of the real relationship of the two.

'After Linnaeus's time many species were added to both genera until by 1846, when Bentham revised the Scrophulariaceae for DeCandolle's *Prodromus Systematis Regni Vegetabilis* (10: 224-248), the two were placed next each other, with 92 species in *Verbascum* and 24 in *Celsia.* Only the number of stamens could be counted upon to distinguish them, while parallel species and sections were recognised in each genus. Most of the species now put in *Celsia* had relatively simple foliage that suggested in aspect Linnaeus's group of *Verbascum;* in fact one of his species, which further acquaintance had shown to have only four stamens had been transferred to *Celsia.* In Bentham and Hooker's *Genera Plantarum* (2: 928-929) of 1873 the two genera were kept apart, but with the comment under *Celsia*: 'Genus a Verbasco non differt nisi staminis quinti defectu, et a nonnullis cum eo jungitur'.

'It was in 1891 that Kuntze (*Revisio Generum Plantarum,* 1: 468) definitely combined *Verbascum* and *Celsia,* making the necessary specific combinations under the former. He commented on the existence of *Verbascum celsoides* Bentham with either 4 or 5 stamens, on the close resemblance of *Celsia coromandeliana* Vahl to *Verbascum virgatum* With., and of *Verbascum arcturus* L. and its associates to

Celsia cretica L.f., on the didynamy of the stamens apparent in much of *Verbascum* as well as in *Celsia*, and finally on Nees' evidence that the fifth posterior stamen is often sterile or incomplete in *Verbascum*.

'In his recent studies of these genera, the most detailed ever made, Murbeck maintains the validity of these two genera, but his eventual treatment involves considerable shifting of species. First appeared his monograph of *Celsia* in Acta Universitatis Lundensis . . . in 1926. Later in the same journal . . . in 1933, came his monograph of *Verbascum*. Comparing the keys to the species in these papers one discovers that in both genera there is a primary division into *Aulacospermae* (with seeds longitudinally 6-9-sulcate and -costate), containing 1 species of *Verbascum* and 6 of *Celsia;* and *Bothrospermae* (with seeds transversely foveolate), containing 251 species of *Verbascum* and 68 of *Celsia*. The flowers were in fasciculate clusters in 199 species of *Verbascum* and 1 of *Celsia;* while they were solitary in each axil in 53 species of *Verbascum* and 73 of *Celsia*. The indumentum consists of branching hairs in most species of *Verbascum*, and in 9 species of *Celsia;* but of simple, often gland-tipped, hairs in the remaining species of *Verbascum* and in most species of *Celsia*. In the later monograph Murbeck transfers to *Verbascum* from *Celsia* a number of 4-stamened species clearly related to 5-stamened species of *Verbascum*, thus eliminating from *Celsia* all fasciculate-flowered species. . . .

'In all this there is little convincing difference. Capsule distinctions, and especially placental ones, were introduced to distinguish both these genera from *Staurophragma* Fisch. & Mey., rather than to contrast *Verbascum* and *Celsia*. But there are definite trends between the latter, which might be summarized as follows: *Verbascum* has stamens usually five, flowers usually fasciculate, and hairs usually branching; and *Celsia* has stamens nearly always four, flowers always solitary to an axil, and hairs always simple. But surely such trends should not constitute genera.

'Murbeck says that he cannot see the necessity of combining *Verbascum* and *Celsia*, and that this is not practicable until one can see where the *Celsia* species will fit into an enlarged genus. From his presentation it is clear enough that *Verbascum* is a simple coherent group, with an amazing preponderance of species in the Levant. . . .

'It seems to me that Kuntze's reasons for uniting *Verbascum* and *Celsia* into a single genus are most cogent, and that we need a phylogenetic rearrangement of the species of the enlarged genus *Verbascum*. Doubtless, the resurrection of the fifth stamen has occurred in more than one sub-group and is of less significance taxonomically than other characters that should be stressed . . .' (Pennell, Scroph. West. Himal., 36-39).

KICKXIA Dumort.

Wetsttein in Engl. & Prantl, Pflanzenfam., 4 (3*b*): 58, 1891, separated the Indian *Linaria ramosissima* Wall. from the genus *Linaria* and placed it under *Elatinoides* (Chav.) Wetstt. The oldest name for the genus is *Elatine* Hill, Brit. Herb. 113, 1756; but the name is already preoccupied by *Elatine* Linn., Sp. Pl. 367, 1753, which is applied to quite a different genus. The oldest valid name is then *Kickxia* Dumort., Fl. Belg. 35, 1827, and this is the name proposed by Pennell, in spite of the fact of the existence of *Kickxia* Blume, 1828, for a genus of the Apocynaceae. The genus *Linaria* is still accepted as a valid one by both Wetsttein and Pennell; the differences between the two genera are given in the following key taken from Pennell, Scroph. West. Himal., p. 58:

Seeds angled or flattened-winged; capsules dehiscing by irregular distal ruptures: corolla large, the spur (15-20 mm. long) as long as the remainder of the corolla; flowers nearly spicate; leaf-blades lance-ovate, sessile; plants erect, glabrous. ... 18. *Linaria.*

Seeds reticulate-alveolate or spinulose; capsules irregularly rupturing or over most of the side, or the side abscissing as a plate; corolla small, the spur 2-5 mm. long, mostly shorter than corolla (4-7 mm. long); flowers on slender pedicels; leaf-blades ovate, rounded or hastate near base, petioled; plants twining, glabrous to villose. ... 19. *Kickxia.*

The following key to the species of *Kickxia* of India is taken from Pennell, loc. cit.:

Whole plant, including the external surface of the corolla, glabrous; corolla yellow throughout, 6 mm. long, the spur strongly curved forward; pedicels frequently much longer than the length of the sepals and capsules. ... 1. *K. ramosissima.*

Whole plant, including the externally pubescent surface of the corolla, hairy, mostly hirsute; corolla 7 mm. long, with the upper lip purplish and palate purple-spotted, the spur deflexed, straight or only slightly curved forward; pedicels usually about the length of the sepals and capsules, occasionally longer. ... 2. *K. incana.*

1. **Kickxia ramosissima** (Wall.) Janchen, in Oesterr. Bot. Zeitschr. 82: 152, 1933; Pennell, loc. cit., p. 59.

Linaria ramosissima Wall., Pl. As. Rar. 2: 43, t. 153, 1831; Hook. f., Fl. Brit. Ind. 4: 251; Dalzell & Gibs., Bomb. Fl. 176; Wight, Illust. 165; Cooke, 282; Gamble, Fl. Madr. 946.

Linaria sp. Graham, Cat. 142.

Elatinoides ramosissima (Wall.) Wetstt. loc. cit.

A tolerably common plant about Bombay on old walls; abundant on the ruins of Bassein Fort, near Bombay; fairly abundant also on the walls of Purandhar Fort near Poona.

2. **Kickxia incana** (Wall.) Pennell, Scroph. West. Himal. 59, 1943.

Linaria incana Wall., Pl. As. Rar. 2: 43-44, 1831; Benth. in DC. Prodr. 10: 270, 1846; Hook. f., Fl. Brit. Ind. 4: 252, 1883.

Linaria cabulica Benth. in DC. Prodr. 10: 270, 1846.

Linaria cabulica var. *pubescens* Hook. f., Fl. Brit. Ind. 4: 251, 1883.

The identity of *Linaria incana* with *L. cabulica* is suggested by Pennell, loc. cit.; I have examined all the sheets assigned to either species in Kew Herbarium and am inclined to agree with Pennell, as I can see no constant difference on which these two species may be distinguished. There is considerable variation in the size of the flowers, and this seems to be the main difference between the two plants. Prain, Beng. Pl. 2: 757, 1903 for *L. incana,* Haines in Bot. Bih. & Or. 619, 1922, and Cooke, 283, for *L. cabulica* state that the spur of the flower is longer than the corolla tube; Wallich, loc. cit., definitely states that the spur is only half as long as the corolla tube, and all my specimens agree with Wallich's remark.

In Cooke's Flora, 283, this plant is placed among Excluded Plants, as there is no evidence of its occurrence within the boundaries of Bombay Presidency proper, except a doubtful specimen from Baluchistan. Bentham, loc. cit., gives the plant as occurring on walls in the Deccan on the authority of Perrottet's specimens which Bentham has examined. I have found the plant on several occasions on the walls of Purandhar Fort near Poona, and in consequence there remains no doubt as to the occurrence of this plant within the limits of Bombay Presidency (Santapau 5307, 23-10-1944; 5582, 23-12-1944; 7193, 3-9-1945; 8184, 22-12-1945). In habit it is very similar to *K. ramosissima,* but the leaves are not hastate, the flowers are smaller with a very small spur, and the whole plant is pubescent, at times densely so.

SUTERA Roth.

Sutera dissecta (Del.) Walp., Rep. 3: 271, 1844; Bruce in Kew Bull. 1940 (2): 63-64.

Capraria dissecta Del., Fl. Egypte 95, t. 32, f. 2, 1812.

Sutera glandulosa Roth, Nov. Pl. Sp. 291, 1821; Hook. f., Fl. Brit. Ind. 4: 258, 1884; Benth. in DC. Prodr. 10: 362, 1846: Wight, Icon. t. 856; Wetstt. in Engl. & Prantl, Pflanzenfam. 4 (3*b*): 69, 1895; Cooke, 285; Gamble, Fl. Madr. 946.

A monotypic genus extending from North Africa through Arabia to India. Found on the banks of rivers or on dry river beds over Western India; the small white flowers, pinnatifid leaves and viscosity of the whole plant are typical and distinguish it from the rest of the Scrophulariaceae.

'There has been some slight confusion over this genus as it was reduced by Willdenow and later revived by Roth. In 1807 Roth published the two species *Sutera foetida* and *S. brachiata;* the former was founded on *Buchnera foetida* Andr. and is the type of the genus *Sutera,* the latter is a synonym of *Manulea hispida* Thunb., for which the new combination *Sutera hispida* (Thunb.) Druce has been made. In 1809 Willdenow reduced *Sutera* to *Manulea,* but twelve years later in 1821, Roth revived the genus and added another species *Sutera glandulosa* Roth. This species is, however, synonymous with *Capraria dissecta* Del. and the new combination *Sutera dissecta* (Del.) Walp. was made. In 1836 Bentham founded three new genera, *Chaenostoma, Lyperia* and *Sphenandra* and incorporated *Sutera foetida* and *Manulea foetida* in his genus *Chaenostoma*. In 1891 Kuntze replaced Bentham's *Chaenostoma* into *Sutera* Roth (1807) and created a new genus, *Jamesbrittenia,* for the species founded on *Sutera glandulosa* Roth. In 1897 Diels revived *Chaenostoma* but treated *Lyperia* and *Sphenandra* as sections of this genus. A few years later *Chaenostoma,* as conceived by Diels, was again reduced to *Sutera* by Hiern. Hemsley and Skan adhered to this arrangement but still considered *Jamesbrittenia,* founded on *Sutera glandulosa,* to be a distinct genus. They separated this from *Sutera* on the character of the shortly two-lobed style. The type of *Jamesbrittenia* has been examined and the minutely bilobed style is present, but this is also present in *Sutera elliotensis* Hiern, so cannot be taken as a separating generic character. There appear to be no characters on which *Jamesbrittenia* can be excluded from *Sutera* Roth 1807. *Sutera* Roth 1821 is therefore synonymous with *Sutera* Roth 1807, and the generic name *Jamesbrittenia* is not required and becomes a synonym.' (E. A. Bruce in Kew Bull., loc. cit.)

BACOPA Aublet.

From the point of nomenclature, probably the most confusing name in the Scrophulariaceae is *Herpestis* or *Monniera*. Bentham & Hooker in Gen. Pl. 2 : 951, give *Herpestis* as the correct name for the genus, and this, as Kuntze remarks, in spite of all the rules of priority; *Herpestis* was only published by Gaertn. in 1805. The oldest name for the genus seems to be *Moniera* B. Juss. ex P. Browne, Hist. Jamaic. 269, 1756. The beginning of the confusion must be attributed to Linne's publication in 1758 of *Monniera* for a plant of the Rutaceae.

As regards the specific name, Linne published in 1756 his *Lysimachia monnieri* in Cent. Pl. 2: 9 the name being changed to *Gratiola monnieri* in 1759 in Syst. Nat., ed. 10, 851 (June 1759), and to *Gratiola monnieria* in Amoen. Acad. 4: 306, Nov. 1759.

O. Kuntze in Rev. Gen. Pl. 462, 1891, gives the following names as synonyms for the same genus, by order of priority : *Monniera* P. Browne, *Gratiola* Linn. p.p., *Brami* Adans., *Bramia* Lamk., *Mella* Vand., *Septas* Lour., *Mecardonia* and *Calytriplex* R. & P., *Herpestis* Gaertn. Wettstein in Engl. & Prantl, Pflanzenfamilien 4 (3*b*) : 76, 1895, and Merrill, Enum. Phil. Fl. Pl. 3 : 435, 1923, take *Bacopa* Aublet, Hist. Pl. Gui. Franc. 1: 128, t. 49, 1775, as the real and legitimate name.

Pennell in his earlier works recognised the following genera as valid : *Herpestis* Gaertn., *Bramia* Lamk., *Bacopa* Aublet, and *Mella* Vand. Of these he considered *Herpestis* and *Bacopa* as two American genera without any representative in the Old World; *Mella* and *Bramia* are also American plants, but they extend to the tropics of the Old World. Pennell in the latest paper on the present question has re-examined the whole problem and decided on the fusion of most of the four genera under a single generic name, *Bacopa,* the genera he had previously accepted being reduced to sections of

Bacopa. In this new arrangement of the genus, Pennell follows Wettstein loc. cit.

Key to the Bombay species of Bacopa:

Corolla campanulate; outer sepal ovate, 2-3 times wider than the innermost sepal; leaf blades cuneate, rounded, 1-veined; prostrate or creeping plants. ... *B. monnieri.*

Corolla zygomorphic; outer sepal rotund, more than 4 times wider than the innermost; leaf blades linear-lanceolate, attenuate to an obtuse apex, pinnately-veined; erect plants:

- Flowers sessile solitary. ... *B. hamiltoniana.*
- Flowers pedicelled, several in an axil. ... *B. floribunda.*

Bacopa monnieri (Linn.) Pennell, in Proc. Acad. Nat. Sci. Philad. 98: 94, 1946.

Lysimachia monnieri Linn., Cent. Pl. 2: 9, 1756.

Gratiola monnieri Linn., Syst. Nat. (10) 851, 1759 (June).

Gratiola monnieria Linn. in Amoen. Acad. 4: 306, 1759 (Nov.).

Bramia indica Lamk., Encycl. 1: 459, 1783.

Monniera cuneifolia Michaux, Fl. Bor. Amer. 2: 22, 1803.

Herpestis monnieri H.B.K., Nov. Gen. Sp. Pl. 2: 366, 1817; Benth, in DC. Prodr. 10: 400, 1846.

Herpesti monniera Benth., Scroph. Ind. 30, 1835; Hook. f. in F.B.I. 4: 272, 1884; Graham, Cat. 144; Sayeedud-Din in *Journ. Bomb. Nat. Hist. Soc.* 41: 321-323, 1939.

Herpestes monnieria Dalz. & Gibs., Bomb. Fl. 178.

Moniera cuneifolia Cooke, 2: 285; Gamble, Fl. Madr. 953.

Bacopa monnieria Wettst. in E. & P., Pfam. 4 (3*b*): 76, 1895; Merrill, Enum. Phil. Fl. Pl. 3: 435, 1923.

Bramia monnieria Drake, Fl. Polyn. Franc. 142, 1893.

Bramia monnieri Pennell, Scroph. South. U.S., in Proc. Acad. Nat. Sci., Philad., 71: 243, 1920; id. in Scroph. Cuba, op. cit., 75: 10, 1923; id. Scroph. East. Temp. N. Amer. 52, 1935; id. Scroph. West. Himal. 23, 1943.

Up to 1943, Pennell considered this plant 'a genus, probably monotypic, occurring through the tropics of both hemispheres, growing especially on and near sea coasts'. (Scroph. West. Himal. 22).

This is a common plant in Western India; in Khandala on the Western Ghauts it is abundant in shallow water in the village tank and in ditches near it. The flowers are blue, generally pale blue, very occasionally pure white.

Bacopa hamiltoniana (Benth.) Wettst. in E. & P., Pfam. 4 (3*b*): 77, 1895; Pennell in Proc. Acad. Nat. Sci., Philad., 98: 92.

Herpestis hamiltoniana Benth. in Wall., Cat. 3898, 1831 nom. nud.; id. in Scroph. Ind. 30, 1835; Hook. f. in F.B.I. 4: 272, 1884; Dalz. & Gibs., 178.

Monniera hamiltoniana Kuntze, Rev. Gen. Plant. 163, 1891.

Monniera hamiltoniana Cooke, Fl. Pres. Bombay 2: 286, 1904; Gamble, Fl. Madr. 953.

Mella hamiltoniana Pennell, Scroph. West. Himal. 43, 1943.

In general appearance this plant is very similar to *Ammannia* sp.; in Kew Herb. there are several sheets showing a mixture of these two plants; the leaves of *B. hamiltoniana* are entire, not serrated or subserrated as those of *Ammannia*; the capsules are practically of the same size in both species and very similar, but the capsules of *Bacopa* are more finely tuberculate than those of *Ammannia.*

Bacopa floribunda (R. Br.) Wettst. l.c.; Pennell, Proc. Acad. Nat. Sci., Philad., 98: 92.
Herpestis floribunda R. Br., Prodr. 442, 1810; Hook. f. in F.B.I. 4: 273, 1884.
Bramia floribunda Muell., in Fragm. Phyt. Austr. 9: 167, 1875.
Monniera floribunda Kuntze, Rev. Gen. Plant. 463, 1891.
Monniera floribunda Cooke, 2: 286, 1904; Gamble, Fl. Madr. 953.
Mella floribunda Pennell, in Journ. Arn. Arb. 24: 248, 1943.

In general this plant is very similar to the preceding species; it differs, however, in having several flowers in most axils; the pedicels may be so short as to be very obscure.

MIMULUS Linn.

Mimulus strictus Benth. in Wall., Cat. 3918, 1830; Scroph. Ind. 28, 1835; Pennell, Scroph. West. Himal. 32, 1943.
Mimulus gracilis auct. plur., non R. Br.

Grant in her monograph of the genus, in Ann. Missouri Bot. Gard. 11: 134, 1925, followed Bentham in identifying *M. strictus* with *M. gracilis.* Pennell has separated them as being two different plants; his reasons seem convincing: 'Although this was reduced to the synonymy of the Australian *Mimulus gracilis* R. Br. by Bentham himself in 1846 (in DC. Prodr. 10: 369) it seems distinct by possessing wider and longer leaves, longer calyces, and shorter pedicels, the Australian plant . . . having linear-oblong to oblong leaves up to 3 cm. long, calyx only 5 mm. long, but pedicels 4-6 cm. long. The two seem to differ also in colour, the corolla of *M. gracilis* being described by Ewart as "violet, purple or blue with yellowish protuberances" while that of the plant of India is stated by J. D. Hooker (F.B.I. 4: 259) to be "white or pale blue".' (Pennell, loc. cit., 32.)

M. strictus has the general appearance of one of the *Limnophilas,* but its flowers are larger, calyces longer, and leaves always opposite, never verticillate nor dissected. In Kew Herb. I have seen no specimens from Bombay; its occurrence in the Presidency is given on the authority of Cooke 2: 287. For critical notes on this species, see Blatter and Hallberg, in *Journ. Bombay Nat. Hist. Soc.* 25: 423, 1918.

STEMODIA Linn.

The generic name *Stemodia* was published by Linne in Syst. Nat., ed. 10: 1118, 1759, and is, therefore, posterior to *Stemodiacra* P.

Br., Hist. Jam. 269, 1756; but *Stemodia* is included among the *nomina conservanda* in the latest edition of the Intern. Rules of Bot. Nomencl. (1935), published in 1947. 'As here understood, this (i.e. *Stemodia*) is quite a natural group, distinguished by separated anther-cells, corolla usually pubescent anteriorly, pedicels short and bibracteolate, and leaf-blades sessile or clasping. Such a characterization is only achieved by the recognition of several tropical groups as distinct genera, as partially indicated by Minod and further developed in my recent papers on the Scrophulariaceae of Colombia and Cuba. The structure of the zygomorphic flowers indicates pollination by bees.' (Pennell, Scroph. East. Temp. N. Amer. 102.)

Flowers clearly pedicelled. ... *S. viscosa.*
Flowers sessile or nearly so. ... *S. serrata.*

1. **Stemodia viscosa** Roxb., Pl. Cor. 2: 33, t. 163, 1798; Hook. f., Fl. Brit. Ind. 4: 265, 1884; Graham, Cat. 143; Dalz. & Gibs., Bomb. Fl. 176; Wight, Icon. t. 1408; Cooke, 288; Gamble, Fl. Madr. 949.
Stemodiacra viscosa Kuntze, Rev. Gen. Pl. 466, 1891.

The viscosity of the plant is one of the characteristics that may help to distinguish it from other members of the family. It is not a common herb, but by no means rare, in rice fields and in dry river beds.

2. **Stemodia serrata** (Hochst.) Benth. in DC. Prodr. 10: 381, 1846; Hook. f., Fl. Brit. Ind. 4: 265, 1884; Cooke, 288.
Sutera serrata Hochst. in Flora 24 (1): Intell., 43, 1841.

This seems to be a rare plant in the Presidency; I have seen no other specimens but those in Kew Herb. In general appearance it is very similar to some of the *Lindernias,* from which it is clearly distinguished by its capsules, which are linear oblong and shorter than the calyx, and by its flowers and fruits which are sessile or nearly so, sessile flowers not being common among the *Lindernias*.

LIMNOPHILA R. Br.

The generic name *Limnophila* R. Br., Prodr. 442, 1810, is given as *nomen conservandum* in the latest edition of the Intern. Rules of Bot. Nomencl., as against *Ambulia* Lam., Encycl. 1: 128, 1783, *Diceros* Lour., Fl. Cochinch. 381, 1790, and *Hydropityon* Gaertn. f., Fruct. 3: 19, 1805.

Key to the species of *Limnophila* adapted from Cooke:

Leaves pinnately nerved; no whorls of pinnatifid leaves:
  Calyx not striate in fruit; leaves opposite, petiolate; flowers sessile. ... *L. rugosa.*
  Calyx striate in fruit:
    Flowers sessile ... *L. conferta.*
    Flowers pedicellate ... *L. aromatica.*

Leaves with 3-5-parallel nerves running from base to tip,
or lower leaves whorled, pinnatifid or multifid;
fruiting calyx not striate.
Flowers sessile or nearly so:
Flowers white in terminal spikes:
Upper leaves crenulate, bracteoles linear-lanceolate,
calyx segments deltoid-ovate, acute ... *L. aquatica.*
Upper leaves serrulate, bracteoles triangular-acute, calyx segments narrowly triangular
subacute or obtuse ... *L. polystachyoides.*
Flowers pink, usually axillary, solitary ... *L. sessiliflora.*
Flowers pedicellate; pedicels usually longer than the
calyx ... *L. indica.*

1. **Limnophila rugosa** (Roth) Merrill, Interp. Herb. Amb. 466, 1917, & Enum. Phil. Fl. Pl. 3: 434, 1922; Pennell, Scroph. West. Himal. 26, 1943.
Herpestis rugosa Roth, Nov. Pl. Sp. 290, 1821.
Capraria gratissima Roxb., Hort Beng. 47, 1814; Fl. Ind. 3: 92, 1832 (non *L. gratissima* Blume).
Limnophila Roxburghii G. Don, Gen. Syst. 4: 543, 1838; Hook. f., Fl. Brit. Ind. 4: 265, 1884; Graham, Cat. 143; Dalz. & Gibs., Bomb. Fl. 177; Cooke, 289; Gamble, Fl. Madr. 951.
Stemodia menthastrum Benth. in DC. Prodr. 10: 386, 1846.
Terebinthina rugosa Kuntze, Rev. Gen. Pl. 468, 1891.

A stout plant for the genus, with leaves (including the petioles) up to 10 × 3 cm.; flowers sessile, clustered in small, nearly sessile heads. Not common in the Presidency.

2. **Limnophila conferta** Benth. in DC. Prodr. 10: 387, 1846; Hook. f., Fl. Brit. Ind. 4: 266, 1884; Dalz. & Gibs., Bomb. Fl. 177; Cooke, 289; Gamble, Fl. Madr. 951.
Ambulia conferta (Benth.) Baillon, Hist. Plant. 9: 454, 1888.
Terebinthina punctata Kuntze, Rev. Gen. Plant. 468, 1891.

When the plant is fully developed, it has the typical looks of most *Limnophilas;* in the young stages it is a difficult plant to classify. I have found it in rice fields in Khandala; but it is rather rare.

3. **Limnophila aromatica** (Lamk.) Merrill, Interpret. Herb. Amb. 466, 1917; Enum. Phil. Fl. Pl. 3: 432, 1923.
Ambulia aromatica Lamk., Encycl. 1: 128, 1783.
Limnophila gratissima Blume, Bijdr. 749, 1826; Hook. f., Fl. Brit. Ind. 4: 268, 1884; Graham, Cat. 144; Dalz. & Gibs., Bomb. Fl. 177; Cooke, 290; Gamble, Fl. Madr. 951 (non Roxb.).

The leaves of this plant are mostly in whorls of 3, and sharply serrate, but not divided.

4. **Limnophila aquatica** (Willd.) Santapau, comb. nov.
Stemodia aquatica Willd., Sp. Pl. 3: 346, 1801.

Limnophila polystachya Benth., Scroph. Ind. 26, 1835; Hook. f., Fl. Brit. Ind. 4: 269, 1884; Wight, Icon. t. 860; Cooke, 290; Gamble, Fl. Madr. 952.
Terebinthina aquatica Kuntze, Rev. Gen. Plant. 468, 1891.

5. **Limnophila sessiliflora** (Vahl) Blume, Bijdr. 749, 1826; Hook. f., Fl. Brit. Ind. 4: 270, 1884; Cooke, 290.
Hottonia sessiliflora Vahl, Symb. Bot. 2: 36, 1791.
Limnophila heterophylla Woodrow, in *Journ. Bomb. Nat. Hist. Soc.* 12: 174, 1898 (non Benth.).
Terebinthina sessiliflora Kuntze, Rev. Gen. Plant. 468, 1891.

6. **Limnophila indica** (Linn.) Druce, in Rep. Bot. Exch. Club Brit. Isl. 3: 420, 1914; Merrill, Enum. Phil. Fl. Pl. 3: 433, 1923; Pennell, Scroph. West. Himal. 26, 1943.
Hottonia indica Linn., Syst. Nat., ed. 10, 919, 1759.
Cyrilla aquatica Roxb., Pl. Cor. 2: 47, t. 189, 1798; Fl. Ind. 3: 115, 1832 (non *Stemodia aquatica* Willd.).
Limnophila gratioloides R. Br., Prodr. 442, 1810; Hook. f., Fl. Brit. Ind. 4: 271, 1884; Graham, Cat. 143; Dalz. & Gibs., Bomb. Fl. 177; Cooke, 291; Gamble, Fl. Madr. 952.
Limnophila racemosa Benth., Scroph. Ind. 26, 1835; Hook. f., loc. cit.; Graham, loc. cit.; Dalz. & Gibs., loc. cit.; Wight, Icon. t. 861; Cooke, 290; Gamble, loc. cit.
Limnophila myriophylloides Roth, Nov. Pl. Sp. 294, 1821.
Limnophila elongata Benth. in Wall. Cat. no. 3903.

Limnophila indica Druce, as here understood, is extended to include both *L. racemosa* and *L. gratioloides* and the several intermediate varieties. I have come to this conclusion after a careful study of the literature and examination of all the Indian specimens preserved at Kew. Often the basis for the separation of the various species and varieties is a question of size; but there seem to be too many intermediate types merging into one another for this distinction to be accepted. Similarly the presence or absence of pubescence is made a specific distinction; most authors make *L. racemosa* pubescent, *L. gratioloides* glabrous; Gamble in the key to the Madras species omits this point and merely mentions that *L. racemosa* has glabrous calyx in fruit, whilst *L. gratioloides* has a pubescent calyx; the specimens preserved at Kew do not show any constant distinction between pubescent and glabrous forms. The strong scent of turpentine is again a doubtful character, as both species possess it in a greater or lesser degree. For the past several years I have been having constant difficulties when dealing with the classification of *L. racemosa* and *gratioloides*, as the typical characters assigned to either plant seemed easily to be found in the other species.

7. **Limnophila polystachyoides** Blatter in Journ. As. Soc. Beng. (N.S.) 26: 352, 1930.

The following is the description of the plant given by Blatter, loc. cit.: 'A paludine herb, 90 cm. long, erect or ascending from a floating portion which is densely clothed with capillaceo-multifid leaves. Stem stout, sparingly and finely muriculate, here and there with a straight hair; upper (flowering) part pentagonal in transverse section. Lower leaves all capillaceo-multifid; upper ones opposite or in whorls of 3 (in the same plant), 2 cm. long, 7 mm. broad, entire; lanceolate-acute to linear in the highest region and much shorter, sessile, serrulate (not crenulate), 3-nerved from base running up to the tip, mostly with an additional pair running half-way up. Flowers sessile in terminal spikes about 6 cm. long; lower part of inflorescence lax, upper very dense with very small floral leaves which are shorter than the flowers. Bracteoles triangular-acute, a little more than 1 mm. long. Calyx 3.5 mm. long, divided half-way down; sepals rounded-keeled on back, slightly subequal, central part of each sepal green; teeth 5, narrow-triangular, as long as tube, subacute or obtuse, finely muriculate on margin and on central line of back with a few hairs at the tips. Corolla at least twice the length of calyx, white, woolly inside. Capsule entirely enclosed by calyx, 4-5 mm. long, ovoid, minutely papillose, glabrous, shining. Seeds brown, elongate, ½ mm. long, broader at apex than at base, 4-5- sided, truncate at both ends, finely tuberculate.'

DOPATRIUM Buch.-Ham.

Dopatrium junceum (Roxb.) Buch.-Ham. ex Benth., Scroph. Ind. 31, 1835; Hook. f., Fl. Brit. Ind. 4: 274, 1884; Graham, Cat. 142; Dalz. & Gibs., Bomb. Fl. 178; Cooke, 292; Blatt. & Hallb., in *Journ. Bomb. Nat. Hist. Soc.* 45. 426, 1918; Merrill, Enum. Phil. Fl. Pl. 3: 435, 1923; Gamble, Fl. Madr. 954.

Gratiola juncea Roxb., Pl. Cor. 2: 16, t. 129, 1798.

A very typical herb, often unbranched, occasionally much branched at or near the base, fleshy below, slender above; fairly common in rice fields or swampy places during the rains. An inconspicuous plant. For corrections and additions to the description as given by Cooke, see Blatt. & Hallb., loc. cit.

Dopatrium junceum var. **multiloba** Blatt. & Hallb. in *Journ. Bomb. Nat. Hist. Soc.* 45: 426, 1918.

The most typical part of the variety seems to be the 5-7-lobed lower lip of the corolla. Corolla is lilac with purple veins.

TORENIA Linn.

For a key to the species, see Cooke.

1. **Torenia cordifolia** Roxb., Pl. Cor. 2: 32, t. 161, 1798; Hook, f., Fl. Brit. Ind. 4: 276; Graham, Cat. 144; Dalz. & Gibs., Bomb. Fl. 180; Bot. Mag. t. 3715; Cooke, 292; Blatt. & Hallb., loc. cit., 422; Gamble, Fl. Madr. 956; Pennell, Scroph. West. Himal. 32, 1943.

The strongly winged calyx is typical of this plant among all the native Scrophulariaceae of Bombay.

2. **Torenia bicolor** Dalz. in Kew Journ. Bot. 3: 38, 1851; Hook. f., Fl. Brit. Ind. 4: 278, 1884; Dalz. & Gibs., Bomb. Fl. 181; Cooke, 293; Gamble, Fl. Madr. 957.

Calyx strongly ribbed, but not winged and much longer than broad; the whole flower is much larger than that of *T. cordifolia* Roxb.

ARTANEMA Don.

Artanema longifolia (Linn.) Merrill, Enum. Phil. Fl. Pl. 3: 436, 1923.
Columnea longifolia Linn., Mant. 1: 71, 1767.
Archimenes sesamoides Vahl, Symb. 2: 71, 1791.
Artanema longiflora Wetstt. in Engl. & Prantl, Pflanzenfam. 4 (3*b*): 79, 1895.

A large herb, with relatively large leaves; a fruiting specimen may prove difficult of identification, as the plant has little at that stage that is clearly typical. The plant, however, is a rare one in the Presidency.

LINDERNIA All

This genus has been extensively treated by Pennell in Scroph. East. Temp. N. America (Acad. Nat. Sci., Philad., Monogr. 1, 1935) and more recently by Mukerjee in the Journ. Ind. Bot. Soc. 24 (3): 127-134, 1945. Most of the rearrangements necessary after the fusion of *Lindernia* All., *Vandellia* Br., *Ilysanthes* Raf. and *Bonnaya* Link & Otto have been made by Pennell and Mukerjee. In the following pages, the species of this genus from Bombay are listed for the convenience of Bombay botanists; the order followed here is that of Cooke, p. 295 & foll.

Key to the Lindernias of Bombay, adapted from Mukerjee:

Capsule about equalling the calyx or shorter:
  Glabrous or sparsely hairy; calyx not divided below the middle ... *L. crustacea.*
  Pubescent with spreading hairs; calyx divided to the base or nearly so ... *L. viscosa.*

Capsule twice as long as calyx or longer:
  Perfect stamens 4:
    Flowering calyx not divided below the middle ... *L. sessiliflora.*
    Flowering calyx divided to the base or nearly so ... *L. cordifolia.*
  Perfect stamens 2:
    Leaves parallel-nerved:
      Leaves entire; pedicels up to 3 cm. long; corolla 3-4 times as long as calyx ... *L. hyssopioides.*
      Leaves often serrate or subserrate; pedicels rarely more than 1 cm. long; corolla twice as long as or shorter than calyx ... *L. parviflora.*

Leaves penninerved :
  Corolla white or red :
    Staminodes present :
      Staminodes hairy :
        Leaves sessile, corolla 6-7 mm. long, fruit 12-15 mm. long ... *L. ciliata.*
        Leaves petioled; corolla 18-20 mm. long, fruit 25-30 mm. long ... *L. ruelloides.*
      Staminodes glabrous :
        Leaves very sharply spinous-serrate, teeth 1-1.5 mm. apart ... *L. bracteoides.*
        Leaves shallowly serrate, teeth about 3 mm. apart ... *L. quinqueloba.*
    Staminodes absent ... *L. estaminodiosa.*
  Corolla blue or violet :
    Corolla 12 mm. or more long :
      Capsules linear-subulate, leaves broadly elliptic to ovate-oblong ... *L. anagallis.*
      Capsules narrowly cylindric; leaves linear or narrowly lanceolate ... *L. verbenaefolia.*
    Corolla 6 mm. or shorter; leaves distantly and shallowly toothed, oblong ... *L. oppositifolia.*

1. **Lindernia crustacea** (Linn.) F. Mueller, Cens. Austral. Pl. 97, 1882; Wetstt. in Engl. & Prantl, Pflanzenfam. 4 (3*b*): 80, 1895; Merrill, Enum. Phil. Fl. Pl. 3: 437, 1923; Pennell, Scroph. West. Himal. 29, 1943; Mukerjee, loc. cit., 130.
  Capraria crustacea Linn., Mant. 87, 1767.
  Vandellia crustacea Benth., Scroph. Ind. 35, 1835; Hook. f., Fl. Brit. Ind. 4: 279, 1884; Graham, Cat. 144; Dalz. & Gibs., Bomb. Fl. 180; Wight, Icon. t. 863; Cooke, 295; Blatt. & Hallb. in *Journ. Bomb. Nat. Hist. Soc.* 45: 420, 1918; Gamble, Fl. Madr. 959.
  Torenia lucida Wall., Cat. 3962.
  Gratiola lucida Willd., Sp. Pl. 1: 103, 1798.

Fairly common about Bombay in rice fields after the harvest, or in moist soil generally throughout the year. I have found it particularly abundant about Khandala. 'Based upon *Capraria crustacea* Linn. of Amboyna this Oriental plant has had a disturbed taxonomic history, having been placed successively in *Torenia*, *Vandellia* and *Lindernia* . . .' (Pennell, Scroph. East. Temp. N. Amer. 139, 1935). The whole plant is glabrous, the capsule somewhat truncated at the apex and as long as or a little shorter than the calyx. For a full description of the plant, see Blatt. & Hallb., loc. cit.

2. **Lindernia viscosa** (Willd.) Merrill, Enum. Phil. Fl. Pl. 3: 439, 1923.
  Hornemannia viscosa Willd., Enum. Pl. Berol. 654, 1809.
  Vandellia hirsuta Buch.-Ham. ex Benth., Scroph. Ind. 36, 1835; Hook. f., Fl. Brit. Ind. 4: 280, 1884; Dalz. & Gibs., Bomb. Fl. 179; Cooke, 295; Blatt. & Hallb., loc. cit., 421; Gamble, Fl. Madr. 959.

Lindernia hirsuta Wetstt. in Engl. & Prantl, Pflanzenfam. 4 (3*b*): 79, 1895; Mukerjee, loc. cit., 131.
Vandellia viscosa Merrill, in Phil. Journ. Sci. (Bot.) 7: 246, 1912.

Not quite as common as the preceding species. In the vegetative stages, this plant might at first sight be taken for one of the *Blumeas,* with which it has remarkable resemblance. For a full critical description see Blatt. & Hallb., loc. cit.

3. **Lindernia cordifolia** (Colsmann) Merrill, Enum. Phil. Fl. Pl. 3: 437, 1923; Pennell, Scroph. West. Himal. 30; Mukerjee, loc. cit., 132.
Gratiola cordifolia Colsmann, Prodr. Desc. Grat. 15, 1793.
Lindernia pedunculata Wetstt. in Engl. & Prantl, Pflanzenfam. 4 (3*b*): 79, 1895.
Vandellia pedunculata Benth., Scroph. Ind. 37, 1835, & in DC. Prodr. 10: 416, 1846; Hook. f., Fl. Brit. Ind. 4: 282, 1884; Dalz. & Gibs., Bomb. Fl. 179; Cooke, 295; Gamble, Fl. Madr. 959.
Vandellia cordifolia G. Don, Gen. Syst. 4: 549, 1837; Haines, Bot. Bih. & Or. 633, 1922.
Tittmania grandiflora Wall., Cat. 3949.

In general appearance, very similar to *Lindernia anagallis* (*Bonnaya Veronicaefolia Spr.*), especially when in fruit. I have not found the plant in Bombay.

4. **Lindernia hyssopioides** (Linn.) Haines, Bot. Bih. & Or. 635, 1922; Mukerjee, loc. cit., 132.
Gratiola hyssopioides Linn., Mant. 174, 1767.
Ilysanthes hyssopioides Benth. in DC. Prodr. 10: 419, 1846; Hook. f., Fl. Brit. Ind. 4: 283, 1884; Dalz. & Gibs., Bomb. Fl. 179; Cooke, 296; Blatt. & Hallb., loc. cit., 419; Gamble, Fl. Madr. 961.
Bonnaya hyssopioides Benth., Scroph. Ind. 34, 1835, & in Wall., Cat. 3866; Graham, Cat. 143.

For a full description of the plant, see Blatt. & Hallb., loc. cit.

5. **Lindernia parviflora** (Roxb.) Haines, loc. cit., 635; Pennell, Scroph. West. Himal. 29; Mukerjee, loc. cit., 132.
Gratiola parviflora Roxb., Pl. Cor. 3: 3, t. 203, 1819, & Fl. Ind. 1: 140, 1832.
Ilysanthes parviflora Benth., in DC. Prodr. 10: 419, 1846; Hook. f., Fl. Brit. Ind. 4: 283, 1884; Cooke, 296; Blatt. & Hallb., loc. cit., 420; Gamble, Fl. Madr. 961.
Bonnaya parviflora Benth., Scroph. Ind. 34, 1835; & in Wall., Cat. 3867.
Bonnaya hyssopioides Wight, Icon. t. 857 (non Benth.).

A very common plant at all times of the year, often frequenting rice fields during the dry season (Blatt. & Hallb., loc. cit.). My experience in Khandala is that generally this plant prefers moist soil, but it also grows well in dry rice fields even during April and May. The length of the corolla generally distinguishes this from the preceding species, but often one and the same plant may show rather large corollas said to be typical of *L. hyssopioides*. For a key to the species of *Ilysanthes*, see Blatt. & Hallb., loc. cit.

6. **Lindernia ciliata** (Colsm.) Pennell, in Journ. Arn. Arb. 24: 253, 1943, & Scroph. West. Himal. 32; Mukerjee, loc. cit., 133.
Gratiola ciliata Colsmann, Prodr. Desc. Grat. 14, 1793.
Bonnaya brachiata Link & Otto, Ic. Plant. Sel. 25, t. 11, 1820; Hook. f., Fl. Brit. Ind. 4: 418, 1884; Graham, Cat. 143; Dalz. & Gibs., Bomb. Fl. 178; Cooke, 297; Blatt. & Hallb., loc. cit., 418.
Gratiola serrata Roxb., Fl. Ind. 1: 140, 1820.
Ilysanthes serrata (Roxb.) Urban, in Berl. Deutsch. Bot. Ges. 2: 436, 1884; Gamble, Fl. Madr. 962.
Vandellia brachiata Haines, loc. cit., 632.

Very common near Bombay and in Khandala during the rains; I have seen specimens in flower only 2 cm. high; towards the end of the rains, it may reach 25 cm. in height. The close serratures of the leaves are typical. For further details, see Blatt. & Hallb., loc. cit.

7. **Lindernia ruelloides** (Colsm.) Mukerjee, loc. cit., 133.
Gratiola ruelloides Colsm., Prodr. Desc. Grat. 12, 1793.
Gratiola reptans Roxb., Fl. Ind. 1: 140, 1820.
Bonnaya reptans Spr., Syst. 1: 410, 1825; Hook. f., Fl. Brit. Ind. 4: 284, 1884; Dalz. & Gibs., Bomb. Fl. 179; Cooke, 297; Gamble, Fl. Madr. 962.
Ilysanthes reptans Urban, loc. cit., 2: 436, 1884.
Ilysanthes ruelleodes Kuntze, Rev. Gen. Pl. 462, 1891.

8. **Lindernia anagallis** (Burm.) Pennell, in Journ. Arn. Arb. 24: 252, 1943, & Scroph. West. Himal. 31, 1943; Mukerjee, loc. cit., 133.
Ruellia anagallis Burm., Fl. Ind. 135, 1768.
Bonnaya veronicaefolia (Retz.) Spr., Syst., 1: 14, 1825; Hook. f., Fl. Brit. Ind. 4: 285, 1884; Graham. Cat. 143; Dalz. & Gibs., Bomb. Fl. 178; Wight, Icon. t. 1411; Cooke, 298; Blatt. & Hallb. loc. cit., 418; Gamble, Fl. Madr. 962.
Gratiola veronicifolia Retz., Obs. 4: 8, 1786; Willd., Sp. Pl. 1: 103, 1798.
Ilysanthes veronicifolia Urban, loc. cit., 436.
Vandellia veronicaefolia Haines, loc. cit., 633.

Lindernia anagallis var. **grandiflora** (Retz.) Mukerjee, loc. cit., 133.
Gratiola grandiflora Retz., Obs. 4: 8, 1786; Willd., Sp. Pl. 1: 105, 1798; Roxb., Pl. Cor. 2: 42, t. 179, 1798.

Bonnaya grandiflora Spr., Syst. 1: 41, 1825; Blatt. & Hallb., loc. cit., 418. Graham, Cat. 143; Dalz. & Gibs., Bomb. Fl. 179.
Bonnaya veronicaefolia var. *grandiflora* Hook. f., Fl. Brit. Ind. 4: 285, 1884; Cooke, 298.

Blatter & Hallberg, loc. cit., state that this variety is the commoner plant in Bombay, the typical variety being rather rare in the Presidency. I have collected a number of specimens especially in Khandala and most of them seem to belong to the variety *grandiflora*.

9. **Lindernia verbenaefolia** (Cols.) Pennell, in Scroph. West. Himal. 31, 1943; Mukerjee, loc. cit., 133.
Gratiola verbenaefolia Colsm., Prodr. Desc. Grat. 8, 1793.
Bonnaya verbenaefolia Spreng., Syst. 1: 42, 1825; Benth. in DC. Prodr. 10: 421, 1846; Dalz. & Gibs., Bomb. Fl. 178; Wight, Icon. t. 1412.
Bonnaya veronicaefolia var. *verbenaefolia* Hook. f., Fl. Brit. Ind. 4: 295, 1884; Cooke, 298.

10. **Lindernia oppositifolia** (Retz.) Mukerjee, loc. cit., 134.
Gratiola oppositifolia Retz., Obs. 4: 8, 1786; Willd., Sp. Pl. 1: 105, 1798 (non Linn, ut scribit Mukerjee).
Bonnaya oppositifolia Spr., Syst. 1: 41, 1825; Benth. in DC. Prodr. 10: 421, 1846; Hook. f., Fl. Brit. Ind. 4: 286, 1884; Graham, Cat. 143; Dalz. & Gibs., Bomb. Fl. 179; Cooke, 298; Gamble, Fl. Madr. 962.
Ilysanthes oppositifolia Urban, loc. cit., 445.
Vandellia oppositifolia Haines, loc. cit., 634.

11. **Lindernia bracteoides** (Blatt. & Hallb.) Mukerjee, loc. cit., 133.
Bonnaya bracteoides Blatt. & Hallb., loc. cit., 416.

12. **Lindernia estaminodiosa** (Blatt. & Hallb.) Mukerjee, loc. cit., 133.
Bonnaya estaminodiosa Blatt. & Hallb., loc. cit., 416.

13. **Lindernia quinqueloba** (Blatt. & Hallb.) Mukerjee, loc. cit., 133.
Bonnaya quinqueloba Blatt. & Hallb., loc. cit., 417.

14. **Lindernia sessiliflora** (Benth.) Wetstt. loc. cit., 79; Mukerjee, loc. cit., 132.
Vandellia sessiliflora Benth., Scroph. Ind. 37, 1835 & in DC. Prodr. 10: 416, 1846; Hook. f., Fl. Brit. Ind. 4: 282, 1884.
Bonnaya micrantha Blatt. & Hallb., loc. cit., 417.

Dr. S. K. Mukerjee, to whom I had sent some of Blatter and Hallberg's type specimens of *Bonnaya micrantha*, informed me in a private letter that he was certain of the identity of *B. micrantha* with *Vandellia sessiliflora*. For my part, I have checked the type sheets of the Bombay plant with those of *Vandellia sessiliflora* in Kew Herbarium; both sets of sheets clearly belong to the same species. A point worth noting, however, is that several of the Kew specimens show hypogeal fruits, and such fruits are absent from Blatter & Hallberg's specimens or from those I have myself collected in Khandala and Purandhar. Moreover, at the latter place, I found this plant to be fairly abundant and widespread especially near Vazirgadh Fort.

PEPLIDIUM Del.

Peplidium maritimum (Linn.) Wetstt. in Engl. & Prantl, Pflanzenfam. 4 (3*b*): 78, 1895; Gamble, Fl. Madr. 963.
Hedyotis maritima Linn. f., Suppl. 119, 1781.
Oldenlandia maritima Roth, Nov. Pl. Sp. 97, 1821.
Peplidium humifusum Del., Descr. Egypt. 148, t. 4, 1812; Hook. f., Fl. Brit. Ind. 4: 287, 1884; Graham, Cat. 142; Cooke, 299.
Microcarpaea cochlearifolia Sm. in Rees Cyclop. 23, no. 2, 1813; Wight in Hook. Bot. Misc. 3: 95, Suppl. t. 29, 1833.

At first sight this plant is remarkably similar to *Portulaca* sp. There are no specimens from Bombay at Kew; but McCann has found the plant near Bombay. The only specimens from Bombay which I have seen are those collected by McCann, I have failed to find the plant in spite of persistent searching for a number of years.

GLOSSOSTIGMA Arn.

Glossostigma spathulatum (Hook.) Arnott ex Benth. in Comp. Bot. Mag. 2: 59, 1836; Hook. f., Fl. Brit. Ind. 4: 288, 1884; Dalz. & Gibs., Bomb. Fl. 180; Cooke, 299, Gamble, Fl. Madr. 964; Pennell, Scroph. West. Himal. 36, 1943.
Microcarpaea spathulata Hook. ex Wight in Bot. Misc. 2: 101 Suppl. t. 1, 1831; Graham, Cat. 142.
Glossostigma diandrum Kuntze, Rev. Gen. Pl. 461, 1891.

VERONICA Linn.

1. **Veronica anagallis** Linn., Sp. Pl. 12, 1753; Hook. f., Fl. Brit. Ind. 4: 293, 1884; Cooke, 301; Wetstt. in Engl. & Prantl, Pflanzenfam. 4 (3*b*): 86, 1895; Blatt. & Hallb., loc. cit., 427.

Veronica anagallis var. **calycina** Blatt. & Hallb., loc. cit., 427.

Blatter & Hallberg found this new variety near the Tapti river in Khandesh in Dec. 1916 (No. 1634); I have not seen the specimen, as apparently it has disappeared from the Blatter Herbarium.

2. **Veronica beccabunga** Linn. var. **attenuate** Blatt. & Hallb., loc. cit., 428.

The authors confess that the plants were not in flower at the time they were collected; I have examined the type sheets, but found them in too poor a state for an exact determination.

BUCHNERA Linn.

Buchnera hispida Buch.-Ham. in D. Don, Prodr. Fl. Nep. 91, 1825; Hook. f., Fl. Brit. Ind. 4: 298, 1884; Dalz. & Gibs., Bomb. Fl. 182; Wight, Icon, t. 1413; Cooke, 301; Gamble, Fl. Madr. 966; Pennell, Scroph. West. Himal. 95.

An erect, generally unbranched herb; Cooke mentions that the colour of the corolla is 'light purple', but I have often seen this plant in the field and the corollas were mostly deep purplish blue turning slightly paler with age. When the main stem is damaged, the plant produces a number of long branches from near the spot of the injury. Common in grass fields. H. L. van Buuren in Poona Agric. Coll. Mag. vols. 5 & 6 writes that this plant is a root parasite on grasses; I have often tried to find the connection between this and the host plant, but without success, the reason possibly being the fibrous and delicate nature of the roots of grasses.

STRIGA Lour.

Key to the Strigas of Bombay adapted from Cooke.

Calyx 4-5-ribbed :		
Parasitic on roots; leaves scale-like	...	*S. gesneroides.*
Not parasitic; leaves linear, not scale-like	...	*S. densiflora.*
Calyx 10-ribbed; flowers yellow or white	...	*S. asiatica.*
Calyx 15-ribbed :		
Corolla white, tube much longer than calyx	...	*S. euphrasioides.*
Corolla yellow, tube about as long as calyx	...	*S. sulphurea.*

1. **Striga gesneroides** (Willd.) Vatke ex Engl. in Abhandl. Preuss. Akad. Wissensch. 28: 1894; Pennell, Scroph. West. Himal. 97, 1843.

Buchnera gesneroides Willd., Sp. Pl. 3: 338, 1801.
Buchnera hydrabadensis Roth, Nov. Pl. Sp. 292, 1821.
Orobanche indica Spr., Syst. 2: 817, 1825.
Buchnera orobanchioides R. Br., App. salt. Voyage Abyss. 74, 1814, nom. nud.; & ex Endl. in Flora 2: 387, t. 2, 1832.
Striga orobanchioides Benth. in Comp. Bot. Mag. 1: 361, t. 19, 1836; Hook. f., Fl. Brit. Ind. 4: 299, 1884; Dalz. & Gibs., Bomb. Fl. 181; Wight, Icon. t. 1414; Cooke, 302; Gamble, Fl. Madr. 967.
Striga coccinea Graham, Cat. 145 (non Benth.).

A parasitic herb growing on the roots of some Acanthaceae; in Bombay, Khandala and Purandhar I have often found this plant on *Lepidagathis cuspidata* Nees, occasionally on *L. trinervis* Nees. It is a large herb, generally about 30 cm. high, and extensively branched; stems purple, mostly dark purple; leaves scale-like, of the same colour as the stem; flowers lighter purple. The whole plant dries black. This is what I consider the typical variety; the stem varies from 15 to a little over 40 cm. (the largest plant collected was 46 cm. high). The tuberous root mentioned by Cooke, is seldom present in Bombay plants; I have never seen this plant growing on rocks.

Striga gesneroides Vatke var. **minor** Santapau, in Kew Bull. 1948: 491, 1949.

A very striking small plant, with the floral structure of *S. gesneroides* but differing in the following particulars:

(*a*) The host plant I have always found to be *Hygrophila Serpyllum* Anders. The presence of the parasite generally reduces the amount of flowers and fruits in the host, or delays flowering, but seldom prevents it altogether.

(*b*) The total length of the stem varies from 1.8 to 8.5 cm. at the flowering stage.

(c) Flowers are conspicuously smaller, being only 2.5-3.5 mm. diam. when fully open.

(*d*) The bracteoles supporting the flowers are either not ciliolate at all, or only very sparsely and minutely so.

(*e*) Branching of the stem from below is rather rare.

(*f*) Stems are generally purple, flowers a little lighter purple; in Khandala I have found plants with green stems and white flowers (Santapau 3416! 3545! 5462!); both types of plants, however, dry black.

A common plant in Khandala, but easily missed on account of its small size; often it scarcely appears above the ground. The white-flowered plants I have only found scattered among numerous purple ones in a rice field on Kune Plateau.

2. **Striga densiflora** Benth. in Comp. Bot. Mag. 1: 363, 1836; Hooke. f., Fl. Brit. Ind. 4: 299, 1884; Dalz. & Gibs., Bomb. Fl. 181; Cooke, 303; Gamble, Fl. Madr. 967.
Buchnera densiflora Benth., Scroph. Ind. 41, 1835.

In general appearance it is very near *S. asiatica* Kuntze, but differs in the structure and number of calyx ribs; it seems to be much less common than *S. gesneroides* Vatke or *S. asiatica* Kuntze; I have seen it in cultivated fields at the foot of Purandhar Hill, where the parasite was abundant and did much damage to crops.

3. **Striga asiatica** (Linn.) Kuntze, Rev. Gen. Plant. 466, 1891; Merrill, in Trans. Amer. Phil. Soc., N.S., 24 (2): 353, 1935.
Buchnera asiatica Linn., Sp. Pl. 630, 1753.
Striga lutea Lour., Fl. Cochinch. 22, 1790; Hook. f., Fl. Brit. Ind. 4: 299, 1884; Cooke, 303; Gamble, Fl. Madr. 968; Pennell, Scroph. West. Himal. 96.
Buchnera hirsuta Wall., Cat. 3869.
Striga hirsuta Benth., in DC. Prodr. 10: 502, 1846; Dalz. & Gibs., Bomb. Fl. 181.

A common plant in Western India, in cultivated fields, parasitic on roots of grasses, especially of *Eleusine coracana* Gaertn. The calyx is always (at least in Khandala and Bombay) 10-ribbed; in flower it is narrowly tubular or cylindric; in fruit it widens considerably. Hairs on stems, leaves and calyx are either simple or more often from a broad whitish tubercular base. Tube of corolla very faintly pubescent outside. The branching of the stem varies considerably, from a slender, simple, unbranched stem to a profusely branched, stout one. Corolla yellow.

Striga asiatica var. albiflora Kuntze, Rev. Gen. Plant. 466, 1891.
Striga lutea Lour.: Hooke. f., Cooke, Gamble, et alior. ll. cc. pro parte.

Generally I have found in the field that plants with white flowers are considerably stouter and more extensively branched than the yellow flowered ones. A very common plant in Khandala, parasitic on the roots of *Eleusine coracana* Gaertn., to which it causes severe damage. It is very similar to *S. densiflora* Benth.,* but the calyx in every specimen examined was 10-ribbed.

4. **Striga euphrasioides** (Vahl) Benth., in Comp. Bot. Mag. 1: 364, 1836; Hook. f., Fl. Brit. Ind. 4: 299; Graham, Cat. 145; Dalz. & Gibs., Bomb. Fl. 181; Cooke, 303; Gamble, Fl. Madr. 968; Pennell, Scroph. West. Himal. 96.
Buchnera euphrasioides Vahl, Symb. Bot. 3: 81, 1794; Wight, Icon. t. 855.

Pennell contrasts this plant with *S. asiatica* so that the plant with white corolla, the tube of which is externally pubescent, and much branched stems is *S. euphrasioides*, whilst the plant with yellow corollas, the tube of which is externally glabrous or merely puberulent, stems simple or much branched is *S. asiatica*. This would suggest that *S. asiatica* var. *albiflora* should be made synonymous with *S. euphrasioides;* the difference however, in the calyx ribbing seems to be constant, 10 ribs in *S. asiatica* and its variety *albiflora,* and 15 ribs in *S. euphrasioides,* and in consequence I consider this a good point for the differentiation of the species.

5. **Striga sulphurea** Dalz. & Gibs., Bomb. Fl. 182, 1861; Hook. f., Fl. Brit. Ind. 4: 300, 1884; Cooke, 304.

Very similar to the preceding species, from which it differs mainly in having yellow flowers and a calyx nearly as long as the corolla tube.

RHAMPHICARPA Benth.

Rhamphicarpa longiflora (Arn.) Benth., in Comp. Bot. Mag. 1: 368, 1836; Hook. f., Fl. Brit. Ind. 4: 300, 1884; Graham, Cat. 145; Dalz. & Gibs., Bomb. Fl. 182; Wight, Icon. t. 415; Cooke, 304; Gamble, Fl. Madr. 969.
Buchnera longiflora Arnott, in Nov. Act. Nat. Cur. 18: 356, 1836.

This is a common and pretty herb growing in grass lands from about July till October. Flowers open at nightfall, and remain open during the night and early hours of the morning; if the day is cloudy, flowers may remain open till about midday, otherwise by about 9 a.m. most flowers have closed. On several occasions I have noticed these flowers fully open at or a little after midnight. Cooke, loc. cit., attributes the name of this plant to Benth. in DC. Prodr. 10: 504, 1846, and sees no incongruity in citing as a reference Graham, Catalogue p. 145, published 1839!

SOPUBIA Buch.-Ham.

Corolla purple; calyx teeth in flower about twice as long as calyx tube: ...	*S. delphinifolia.*
Corolla yellow; calyx teeth in flower about as long as the tube: ...	*S. trifida.*

1. **Sopubia delphinifolia** (Roxb.) G. Don, Gen. Syst. 4: 560, 1837; Hook. f., Fl. Brit. Ind. 4: 302, 1884; Graham, Cat. 145; Dalz. & Gibs., Bomb. Fl. 182; Cooke, 305; Blatt. & Hallb., loc. cit., 428; Gamble, Fl. Madr. 970.
Gerardia delphinifolia Roxb., Pl. Cor. 1: t. 90, 1795.

Common in cultivated lands and in grass fields at the close of the rains and the first part of October. Flowers are rose coloured or light purple. Capsules are conspicuous and very distinctly one-sided, the remains of the stigma always being inclined to one side. An elegant herb when in full bloom. For the many variations in the species, see Blatt. & Hallb., loc. cit.

2. **Sopubia trifida** Buch.-Ham. in D. Don, Prodr. Fl. Nep. 88, 1825; Hook. f., Fl. Brit. Ind. 4: 302, 1884; Cooke, 306; Blatt. & Hallb., loc. cit., 429; Gamble, Fl. Madr. 970; Pennell, Scroph. West. Himal. 95, 1943.
Gerardia scabra Wall., Cat. 3889.
A rare plant in the Presidency, according to Cooke.

LINDENBERGIA Lehm.

Lindenbergia indica (Linn.) Kuntze, Rev. Gen. Plant. 462, 1891.
Dodartia indica Linn., Sp. Pl. 633, 1753.
Lindenbergia ruderalis Voigt, Hort. Sub. Calcut. 501, 1845; Kuntze, loc. cit., 462; Pennell, Scroph. West. Himal. 25, 1943.
Stemodia ruderalis Retz., Obs. 5: 25, 1789.
Lindenbergia urticaefolia Lehm., in Link & Otto, Ind. Sem. Hort. Hamb. 1829: 5, 1830; Hook. f., Fl. Brit. Ind. 4: 262, 1884; Graham, Cat. 143; Dalz. & Gibs., Bomb. Fl. 176; Hook. Icon. Pl. t. 875; Cooke, 307; Blatt. & Hallb., loc. cit., 242.
Lindenbergia polyantha Royle ex Benth., Scroph. Ind. 22, 1835; Hook. f., Fl. Brit. Ind. 4: 262, 1884; Cooke, 307.

As is clear from the list of synonyms, I have followed Blatt. & Hallb., in reducing *L. polyantha* to *L. urticaefolia*; the oldest name for the group is *Dodartia indica* Linn., from which the new combination was made by Kuntze. For a full discussion of the reasons for the fusion of the two hitherto accepted species into one, and for the many intermediate forms between the two extremes, see Blatt. & Hallb., loc. cit.

CENTRANTHERA R. Br.

Centranthera nepalensis D. Don, Prodr. Fl. Nep. 88, 1825; Pennell, Scroph. West. Himal. 93, 1943.

Centranthera hispida Hook. f., Fl. Brit. Ind. 4: 301, 1884; Graham, Cat. 145; Dalz. & Gibs., Bomb. Fl. 182; Cooke, 308; Merrill, Enum. Phil. Fl. Pl. 3: 442, 1923 (non R. Br.).

In modern Indian floras this plant is generally placed under *C. hispida* R. Br.; Pennell, however, loc. cit., has called attention to the clear differences between *C. hispida* R. Br. and *C. nepalensis* Don. Speaking of *C. nepalensis* Pennell states that the descriptions . . . give the corolla as purple, Roxburgh calling the tube 'a deep purplish red' and the lobes 'rose coloured'. This furnishes the most obvious difference from *C. cochinchinensis* (Lour) Merr. (*C. hispida R. Br.*) with which it has long been placed. . . .

Corolla yellow, 17-20 mm. long; both pairs of filaments villose-ciliate; seeds spirally ridged, not reticulate; bracts shorter than the calyces; stem 4-10 dm. tall. *C. cochinchinensis.*

Corolla purple, 13-15 mm. long; filaments less hairy, the posterior pair glabrate, the anterior villose-ciliate; seeds evidently reticulate, not spirally marked; bracts (unless occasionally the uppermost) longer than the calyces; stem 0.5-5 dm. tall. *C. nepalensis.* (Pennell, loc. cit.)

A common plant in Bombay Presidency; I have examined a fairly large number of specimens from Khandala and in every detail they correspond to *C. nepalensis* Don as described by Pennell. A very variable plant; flowers in Khandala often reach 20 mm. long; the colour of the corolla is deep purple inside the corolla tube, pale rosy-purple in the limb, occasionally entirely and uniformly white. The seeds are distinctly reticulate, but the reticulations have a slight spiral twist.

PEDICULARIS Linn.

Pedicularis zeylanica Benth., Scroph. Ind. 54, 1835; Hook. f., Fl. Brit. Ind. 4: 317; Wight, Icon. t. 1419; Prain, Spec. Pedic. in Ann. Roy. Bot. Gard. Calcutta 3: 153, t. 14, f. 15-21, 1891; Cooke, 309; Gamble, Fl. Madr. 972.

A rare plant in the Presidency; I have seen no specimen from Bombay; it seems to be fairly common on the Nilgherries.

ANTIRRHINUM Linn.

Antirrhinum majus Linn., Sp. Pl. 617, 1753; Dalz. & Gibs., Bomb. Fl., Suppl. 64; Wetstt. in Engl. & Prantl, Pflanzenfam. 4 (3*b*): 42, f. 18D: 45, f. 22 L-M, 1895; Cooke, 309; Pennell, Scroph. East. Temp. N. Amer. 317, 1935.

A north American plant. Bentham, in DC. Prodr. 10: 291, 1846, states that it has been cultivated for a long time in gardens, from which it has escaped and in now in consequence found almost naturalized in middle Europe, in India, etc. I have seen the plant in gardens both in Europe and India, but have not seen it growing wild anywhere.

MAURANDIA Ort.

1. **Maurandia antirrhiniflora** H. & B. ex Willd., Enum. Hort. Berol. 659, 1809; Pennell, Scroph. East. Temp. N. Amer. 315, 1935.
Maurandia personata Lag., Gen. et Sp. Nov. 19, 1816.
Maurandya antirrhiniflora Graham, Cat. 142.
Maurandya antirrhinifolia Dalz. & Gibs., Bomb. Fl. Suppl. 64.
Antirrhinum maurandioides A. Gray in Proc. Amer. Acad. 7: 376, 1868.

2. **Maurandia semperflorens** Ort., Nov. Plant. Descr. Decad. 21, 1797. Dalz. & Gibs., Bomb. Fl., Suppl. 64; Cooke, 309; Pennell, Scroph. East. Temp. N. Amer. 314, 1935.
Maurandya semperflorens Bot. Mag. t. 460; Graham, Cat. 142.

3. **Maurandia scandens** (Don) A. Gray in Proc. Amer. Acad. 7: 377, 1868; Cooke, 309.
Lophospermum scandens D. Don, in Trans. Linn. Soc. 15: 353, 1827; Dalz. & Gibs., Bomb. Fl., Suppl. 64.

RUSSELIA Jacq.

Russelia equisetiformis Schlecht & Cham. in Linnaea 6: 377, 1831.
Russelia juncea Zucc. in Flora 15 (2) Beibl.: 99, 1832; Dalz. & Gibs., Bomb. Fl., Suppl. 64; Cooke, 310.
Russelia floribunda Woodrow in Journ. Bomb. Nat. Hist. Soc. 12: 174, 1898 (non H.B.K.).

SCOPARIA Linn.

Scoparia dulcis Linn., Sp. Pl. 116, 1753; Hook. f., Fl. Brit. Ind. 4: 289, 1884; Cooke, 310; Blatt. & Hallb. loc. cit., 426; Gamble, Fl. Madr. 964; Merrill, Enum. Phil. Fl. Pl. 3: 441, 1923; Pennell, Scroph. East. Temp. N. Amer. 109, 1935, & Scroph. West. Himal. 22, 1943.
Gratiola micrantha Nutt. in Am. Journ. Sci. 5: 287.
Scoparia grandiflora Nash in Bull. Torr. Bot. Club 23: 105, 1896.

For the distribution of this plant in India, see Blatt. & Hallb. loc. cit. I have found it to be a common herb all over Bombay and Salsette islands; along the railway line in Karjat at the foot of the Ghauts, in Khandala along the main road, and at the foot of Purandhar Hill, 27 miles S.E. of Poona.

MAZUS Lour.

1. **Mazus japonicus** (Thunb.) Kuntze, Rev. Gen. Plant. 462, 1891; Pennell, Scroph. East. Temp. N. Amer. 137, 1935; Merrill in Trans. Am. Phil. Soc. (2 ser.) 24 (2): 349, 1935.
Lindernia japonica Thunb., Fl. Jap. 253, 1784.
Mazus rugosus Lour., Fl. Cochinch. 385, 1790; Dalz. & Gibs., Bomb. Fl. 176; Blatt. & Hallb., loc. cit., 424.

For the occurrence of the plant in Bombay Province, see Blatt. & Hallb., loc. cit.

2. **Mazus McCannii** Blatt. & Hallb., in Journ. Bomb. Nat. Hist. Soc. 25: 423, 1918.

MICROCARPAEA Br.

Microcarpaea muscosa R. Br., Prodr. 436, 1810; Hook. f., Fl. Br. Ind. 4: 286, 1884; Benth., in DC. Prodr. 10: 433, 1846; Gamble, Fl. Madr. 963; Santapau, in Journ. Bomb. Nat. Hist. Soc. 46: 381, 1946.

For the description of this plant and its occurrence in Bombay, see Santapau, loc. cit.

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NOTES ON *TURDUS MERULA* IN SOUTH INDIA

BY

S. DILLON RIPLEY

In the winter of 1947 I collected a number of blackbirds in the Nilgiris and Biligirirangan Hills which on later examination in the Museum at Yale appeared highly provocative. For assistance and the loan of material of this species I am grateful to Mr. J. L. Peters of the Harvard Museum, and to the authorities of the American Museum of Natural History. I am most grateful also to Lt.-Col. E. G. Phythian-Adams and Randolph C. Morris, Esq., for assistance in collecting specimens.

Whistler and Kinnear in the Eastern Ghats Survey (1932) have discussed exhaustively the range of the non-Himalayan Indian blackbirds but I cannot entirely agree with their conclusions. In the first place published records of the occurrence of one race or the other in an area are without subspecific value unless substantiated by specimens. In the second place my collections show the occurrence of two forms of the blackbird in the Nilgiris thereby reversing Whistler and Kinnear's systematic conclusions.

Specimens taken by me were collected in March and were presumably on their breeding grounds, as some birds were coming into breeding condition and all were singing. Birds were taken north of Ootacamund at Kalhatti on the northern fringe of the Nilgiri Plateau at 5,250 feet, and on Dodabetta, the hill south-east of Ootacamund, at 8,650 feet and at Avalanche in the south-western part of the Plateau at 6,500 feet. These birds definitely divide into two groups. The lower altitude birds from the northern part of the Plateau may be listed as Type A. They are distinctly brownish below and grayish-brown above, with, in the male, a tendency to a paler brown nuchal ring and a well-defined black cap. The birds from the higher altitudes and the more southerly parts of the Plateau may be listed as Type B. They are distinctly grayish-brown below and darker blackish-gray above with a black cap which shades into the back without any well-defined demarcation.

Through the kindness of Mr. J. L. Peters, specimens of both these phenotypes have been compared with Lafresnaye's type of *Turdus nigropileus* in the Harvard Museum of Comparative Zoology. Although the type is old and very faded, as well as being in worn plumage, it has a distinct black cap and auriculars and appears to be the black-capped brown bird of the northern part of the Nilgiri Plateau, my Type A above.

Jerdon (1862) discussing his *Merula simillima,* describes it as 'entirely black, conspicuously darker on the head and back of neck; somewhat lighter beneath, and tinged with dusky-brownish.' He gives its range as the summit of the 'Neilgherry' and 'Pulney' hills. From the above it seems quite clear that *simillimus* is my Type B.

From the above it will be seen that two populations occur in the Nilgiris, one in the lower parts from Ootacamund north, the other on the higher slopes to the south of that town. I hereby restrict the type locality of *nigropileus* to 'Kalhatti, Northern Nilgiri Plateau', and of *simillimus* to 'Avalanche, higher Southern Nilgiri Plateau'.

Comparing specimens from the Western Ghats, Biligirirangan Hills and northern Nilgiris it seems apparent that there is a distinct cline in color, the palest birds being found naturally to the north and the darkest being my Kalhatti specimens. In addition Kalhatti birds have the most rounded wings. However, I do not believe that these differences are sufficient to require the retention of the name *mahrattensis* proposed by Whistler and Kinnear (1932).

I would, therefore, retain the following forms:

Turdus merula nigropileus (Lafresnaye).

Synonym: *Turdus simillimus mahrattensis* Whistler and Kinnear.

Range: Evergreen biotope in the Western Ghats from Surat to Malabar (probably including Coorg), Biligirirangan Hills and Bandipur in Mysore and northern fringe of Nilgiri Plateau. On the eastern side of the Peninsula to the Nallamalai Hills (Ferahabad *vide* Whistler 1933). In winter northern birds apparently wander south as far as the Cardamom Hills and the Travancore ranges where individuals may be found from November at least through March.

Turdus merula spencei Whistler and Kinnear

Range: Evergreen sholas in Eastern Ghats from the Seshachalam Hills and probably the Palkonda and Velikonda range north to the hills of Bastar and Jeypore. Apparently intergrades with *nigropileus* in south-eastern Hyderabad (Nallamalai Hills).

Turdus merula simillimus Jerdon

Range: Evergreen sholas in the higher hills of the central and southern Nilgiri Plateau, the Brahmagherries and south to the Palni Hills where it intergrades with the next race. A resident, non-migratory race.

Turdus merula bourdilloni (Seebohm)

Range: Evergreen forest in the higher hills of Travancore north to the Nelliampathies and Palnis where it intergrades with *simillimus*. A resident, non-migratory race.

Turdus merula kinnisii (Blyth)

Range: Dense evergreen and pines in the central highest hills of Ceylon. A resident race.

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A NOVEL METHOD OF DESTROYING MAN-EATERS AND CATTLE-LIFTERS WITHOUT FIREARMS.

BY

S. R. DAVER

Deputy Conservator of Forests, C.P. and Berar Forest Service.

(*With a plate and* 11 *text figures*)

FOREWORD

In introducing this article I need only explain that Shri S. R. Daver, Deputy Conservator of Forests started his career in the Central Provinces as a Range Officer in 1916 and has been serving in these forests for 33 years, of which nine were spent as Chief Forest Officer, Bastar State and seven as D.F.O. Bilaspur. The article itself is, however, sufficient evidence of its genuineness. Whether tigers of other parts would show sufficient boldness to fall a victim to 'Soori Phanda' is a matter for debate but in many parts, where one has had experience of the extreme cautiousness of tigers and their disinclination to return to kills which have been disturbed, it would appear doubtful. Perhaps it depends on the relative ease with which a tiger or panther can obtain a second kill.

I commend the article as a slice of real life which will, I am sure, provide plenty of discussion.

C. E. HEWETSON
I.F.S.

INTRODUCTION

During recent years man-eaters and cattle-lifters have increased in the Central Provinces and Berar at such an alarming rate that very few districts are free from these pests. The district in which the writer is serving is not only overrun with cattle-lifters, but a man-eating tigress played havoc for more than a year before she was brought to book. This fact led the writer to investigate the methods adopted by Baigas to destroy such carnivora. There is no tribe or people in the world who could master the art of trapping animals better or outdo a Baiga in it. Someone has said that Nature never yields her secret lightly. A Baiga is Nature's child, and as such so secretive that one can get very little information out of him. But when the questions and information sought refer to trapping animals, one is treading on delicate ground, particularly when the questioner happens to be a Forest or Police Officer. In spite of all these difficulties the writer succeeded in winning the Baigas' confidence and they demonstrated their method of destroying cattle-lifters, when an actual 'kill' occurred during his tour in May 1949 in Mandla District. Unfortunately in this instance the tiger was not destroyed.

The writer does not claim originality in the device adopted for killing tigers and panthers. He has merely attempted to describe in words and explain by sketches, how tigers and panthers are destroyed by aboriginals. If by chance any reader succeeds in destroying cattle-lifters or man-eaters by this method he should thank and remember our simple friends—the Baigas.

Man-eaters and Cattle-lifters

(1) Abnormal increase of Cattle-lifters and Man-eaters in Central Provinces and Berar:—

'With the departure of shikar-minded people from India, the cattle-lifters have increased' said one of the senior ministers of this Province. To prove how true this observation is, one has only to turn over the pages of *C.P. and Berar Gazette*. The writer has analysed the notices in *C.P. and Berar Gazette,* dated 6-5-1949 in Part IV, pages 210-214 as detailed below:—

(*a*) (i)	Total number of separate rewards offered	Rs. 40
(ii)	Total amount of rewards offered	Rs. 3,580
(iii)	Highest amount of single rewards offered	Rs. 400
(iv)	Minimum reward offered	Rs. 5 (for wolf)
(v)	Number of rewards offered for killing man-eating tigers	17
(vi)	Number of rewards offered for killing man-eating panthers	1
(vii)	Number of rewards offered for killing cattle-lifters	21
(viii)	For wolf	1
	Total ...	40

(*b*) If the area infested by proscribed cattle-lifters and man-eaters is analysed district by district, we get the following result:—

(1) Bhandara, (2) Balaghat, (3) Sarguja, (4) Wardha, (5) Chanda, (6) Jubbulpore, (7) Hoshangabad, (8) Mandla, (9) Bastar, (10) Chhindwara, (11) Nimar, (12) Bilaspur, (13) Buldhana, (14) Raipur and (15) Amraoti.

Since the notices are published once every month, the list of districts infested is not exhaustive. In the writer's opinion, there could be no district free from cattle-lifters in the C.P. and Berar.

(2) Once a cattle-lifter, never a game-killer:—

When tigers take to cattle-lifting, it becomes increasingly difficult for them to catch and kill agile wild game. Firstly, the tiger finds it very easy to strike down a domestic animal. Secondly by eating bovine cattle, it develops into a heavy and weighty animal unable to chase and obtain wild game in the battle-field of jungle life.

(3) Heavy economic loss to cattle owners:—

(i) Man-eaters are mostly disabled animals. Either they are wounded by shikaris or by porcupine quills, or their canine fangs have decayed due to old age. Whenever possible they kill bovine cattle and sometimes human beings also. Hence a cattle-lifter in pursuit of its food requirements is also quite frequently a man-eater.

(ii) All sportsmen agree that a tiger or a panther must kill an animal at least once a week for food. Even on the very conservative estimate of only 3 kills per month, the number of cattle required by a single cattle-lifter works out to $3 \times 12 = 36$ a year.

Therefore, the 39 man-eaters and cattle-lifters notified in *C. P. Gazette* of 6-5-1949, if not destroyed for a period of 12 months, would require to kill $39 \times 12 = 468$ bovine animals. If the present value of a buffalo or a cow is taken only as Rs. 100 then the economic loss entailed would be $468 \times 100 =$ Rs. 46,800.

(4) Reasons for increase of carnivora:—

The increase of carnivora in the C.P. and Berar is due to the following reasons:—

(i) Departure of shikar-minded people from India:—

Every year civilians and army officers used to visit forest blocks and thin out tigers and panthers in almost every district of the C.P. But now-a-days civil officer's tours in forest lands have diminished considerably owing to pressure of heavy office work. On the other hand, few young officers of the Army, Navy and Air Force are keen to spend money and time on shikar The writer has suggested that a copy of notices regarding offer of rewards, appearing in the *C.P. Gazette* should be supplied by the C.P. Government to Army, Navy and Air Force Headquarters and young officers should be made shikar-minded not for the sake of the rewards but to get training in jungle warfare. It is said that 'the jungle is the battle field of our play hours'.

(ii) Withdrawal of ordinary rewards:—

A few years back, rewards used to be paid in the C.P. for destroying carnivora as follows:—

Tiger	...	Rs. 15
Wild Dog	...	Rs. 15
Panther	...	Rs. 10

These rewards were no inducement to the class of sportsmen who used to reserve shooting blocks in Government forests. Only local village shikaris used to sit up over 'kills' and shoot tigers or panthers, and draw rewards from the nearest treasury on production of a skin. Now-a-days, firearms as well as ammunition are very costly; and on top of this, Government, instead of increasing the rate of rewards, have withdrawn the ordinary rewards. No local shikari would care to waste his precious shot and gun powder in shooting a tiger or panther. The writer estimates that local shikaris used to destroy or thin out at least 50 tigers and panthers a year in the C.P. and draw the prescribed rewards from treasuries. In the *C.P. Gazette* of

6-5-1949, Government have announced an enhanced reward for destroying carnivora so that the total amount for these 40 cases now comes to Rs. 3,580. If all these carnivora had been destroyed by local shikaris on payment of the ordinary reward, it would have cost Government 40 × 15 = Rs. 600 only. Is it not more economical for Government to keep down the number of cattle-lifters and man-eaters by reintroducing ordinary rewards?

(iii) Increase of Wild Dogs:—

Owing to withdrawal of rewards, wild dogs have increased by leaps and bounds. In one shooting block, a permit holder witnessed a pack of twenty in one day in the Bilaspur Division, in May 1949.

Wild dogs destroy and wipe out game in forest, consequently tigers or panthers are forced to turn their attention to men or cattle for their food. The sooner the Government restore or even enhance the ordinary rewards for destruction of wild dogs, the better for the wild game and lesser chances of tiger and panther becoming man-eaters and cattle-lifters.

(iv) Increase of gun licences and decrease of herbivora:—

In many tracts, herbivora have been over shot due to the liberal grant of gun licences. In such tracts tigers and panthers have of necessity to depend on bovine cattle or even take to killing human beings. Gun licences should be restricted and strictly controlled, and Pardhis should not be allowed to trap game animals.

Summary of Recommendations

(*a*) Restoration of ordinary rewards for the destruction of tigers, wild dogs and panthers.

(*b*) Encouraging Army, Navy and Air Force officers to shoot in Government and private forests.

(*c*) Regulating gun licences and pardhi's trapping licences.

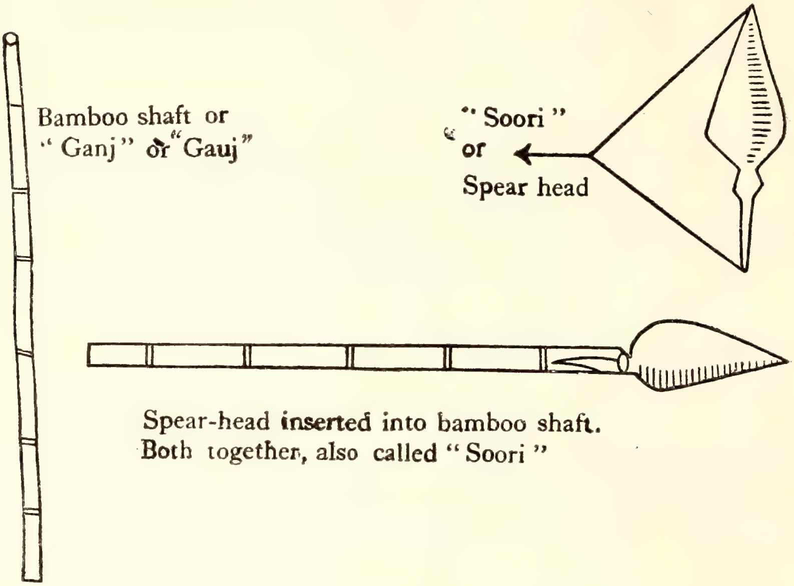
(*d*) In the wildest inaccessible areas, where sportsmen cannot readily reach, or in areas where man-eaters or cattle-lifters are a menace, the 'Soori Phanda' device, described in the following pages should be encouraged.

'Soori Phanda'

The Baigas of Mandla District destroy cattle-lifters by a device known as 'Soori Phanda'. Being past masters in the art of trapping wild animals, they have used this device to destroy cattle-lifting panthers or tigers for generations.

In feudal ages, the game laws were so strict, that it was a grave offence for an ordinary man to shoot or kill a game animal. In India the tiger is considered the king of the forests, and only a few privileged persons like rajas, nawabs and high officials could shoot it. The shooting of tiger by a common person was viewed with great disfavour. Against such a background no wonder the Baigas consider it unwise and unsafe to advertise their 'Soori Phanda' to the world. Unofficially the writer came to know of the killing of one cattle-lifting tiger and two panthers within 3 years in one Range by means of the 'Soori Phanda' method.

'Soori' in Baiga language means spear-head. 'Phanda' means trap. The spear-head together with a wooden shaft is also called a 'Soori' but a detached shaft separated from spear-head is called 'ganj' or 'gauj'. The sketch below will give a better idea.


Bamboo shaft or
" Ganj " or " Gauj "
" Soori "
or
Spear head
Spear-head inserted into bamboo shaft.
Both together, also called " Soori "

EQUIPMENT AND CONDITIONS NECESSARY FOR 'SOORI PHANDA'.

The whole object of this device is to make the tiger or panther fall on a number of spears planted in the ground with spear-heads pointing skywards. To be successful, the following equipment and conditions are necessary:—

(1) There must be a 'kill' by a tiger or panther. The 'kill' may be a bovine carcass or a human body.

(2) There must be two young trees, forking at a height of 13 feet to 15 feet from ground level and standing 10 feet to 12 feet apart.

(3) A barked pole made from *Kydia calycina* known as bargha or Baranga in Hindi.

(4) 12 to 16 iron spear-heads with an equal number of bamboo shafts.

(5) Rope made from the Mahul climber (*Bauhinia vahlii*).

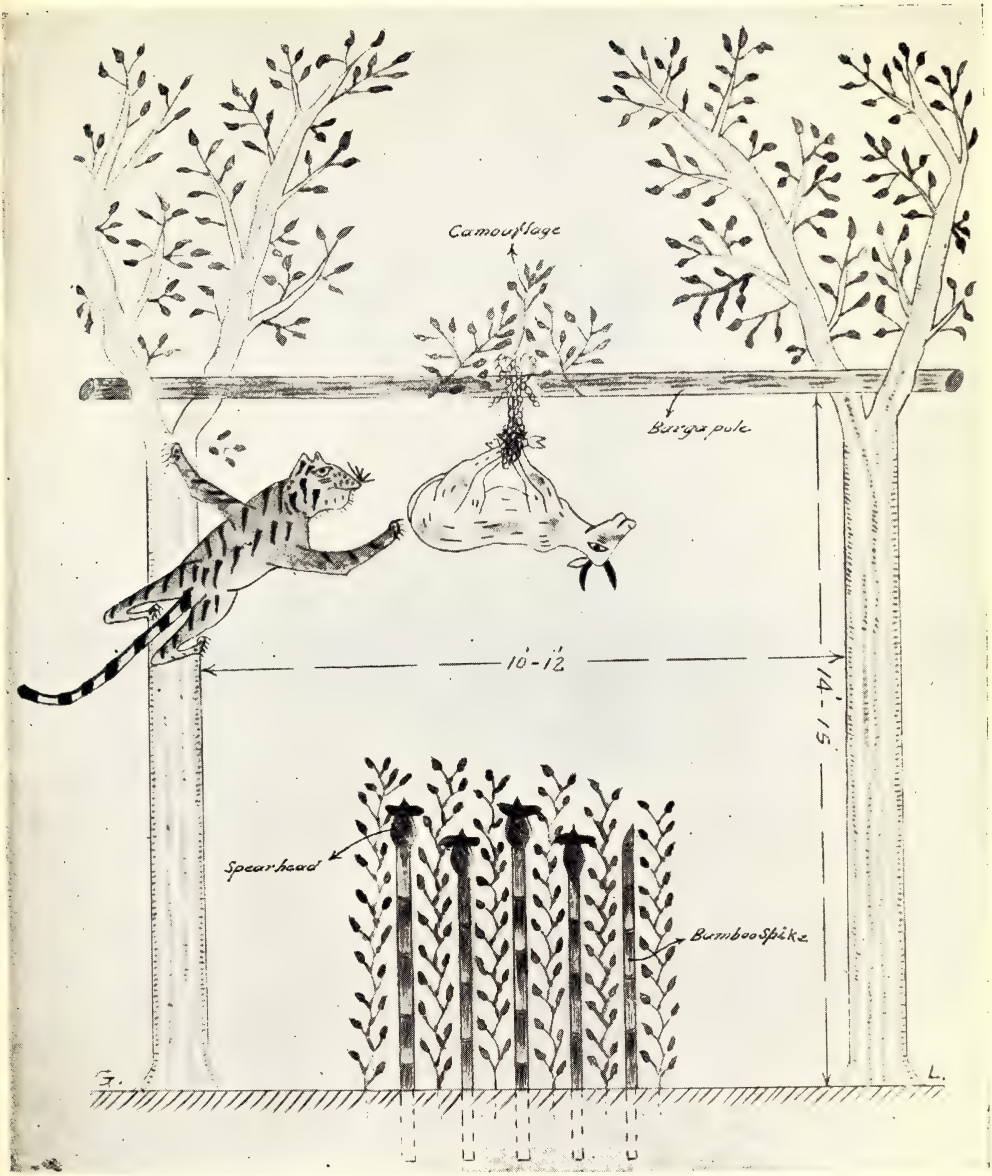
(6) A pole for levering up and lifting a heavy carcass.

(7) Green branches and twigs for camouflage.

(8) A 'Khanita' or iron instrument (drill) for digging holes in the ground.

(9) A number of villagers to help in lifting the carcass and for arranging the 'Soori Phanda'.

I will take up the above nine items separately and explain in detail the precautions necessary.


Camouflage
Barga pole
10'-12'
14'-15'
Spearhead
Bamboo Spike
G.
L.

A 'SOORI PHANDA' IN ACTION
(Sketch by author)

1. The 'Kill'

If the 'kill' happens to be a small animal, 'Soori Phanda' is organised with ease. For this reason the number of panthers destroyed is much larger than that of tigers. Tiger 'kills' are usually large bovine animals, sometimes even fullgrown buffaloes. To sling and lift such heavy 'kills' 15 feet above the ground level by means of props requires about 30 to 40 men.

In Mandla District and elsewhere a cattle-lifter frequently kills more than one animal at a time. At Ramnagar, a village 4 miles from Karanjia, a cattle-lifter attacked 5 cattle and killed 3 outright. Of these, the tiger finished off one young cow during the night, and dragged and collected the remaining two in one spot—this was in May 1949. Hence before arranging 'Soori Phanda', it is essential to search thoroughly the jungle in which a 'kill' is discovered. If there are more than one 'kill', it is useless to expect a tiger to visit 'Soori Phanda'. To be successful there must be only a single 'kill', or if more than one the others must be removed or destroyed.

2. Selection of two Standing Trees

To support a horizontal pole of 'Bargha' two forked trees should be selected. They must be 10 to 13 feet apart. The forking points should be 14 to 15 feet from ground level. Such ideal conditions do not often exist close to the 'kill'. If the 'kill' is heavy, it is difficult to move it a long distance, and moreover such removal may make the tiger suspicious. To get over these difficulties in the jungle, the Baigas sometimes select one or both the trees without a fork. In such cases, they cut one or two forked poles without disturbing the jungle, and these poles are strapped upright to the selected trees and the transverse pole of the Bargha rests on these props.

Size of the trees.—If the trees selected are too thick and large in girth, the tiger or panther finds it difficult to climb them. On the other hand, if the trees are too thin and small in girth, it is equally difficult for the tiger to climb. In making a selection the Baigas prefer trees of 2 feet to 3 feet in girth.

Choice of species.—If there be a choice, they always select Bija (*Pterocarpus marsupium*) trees. Tigers for no apparent reason always delight in climbing Bija trees. This is common knowledge among Baigas and forest officials in Mandla forests. One can see numerous Bija trees with the tell-tale marks of tiger climbing them. If a Bija tree is scratched with a sharp instrument, an astringent blood-coloured gum exudes. A tiger's claws are full of septic particles of the decomposed flesh of its victim, and sometimes the claws may have wounds. It is possible that the oozing astringent Bija gum may have a healing effect, or it may act as disinfectant. Research on the antiseptic properties of Bija gum may prove beneficial in medical treatment.

Other suitable tree species are Karra (*Cleistanthus collinus*), Amti (*Bauhinia racemosa*) and Sal (*Shorea robusta*). Baigas believe that tigers do not climb Dhaura (*Anogeissus latifolia*), Salai (*Boswellia serrata*) and Kulu (*Sterculia urens*).

As a general guide any tree of suitable size (2 feet to 3 feet girth) with rough bark may be selected. Two such standing trees are required.

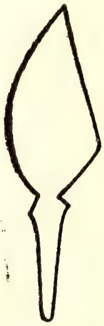
3. A Barked Pole of Bargha or Baranga (*Kydia calycina*)

In the forks of the two vertical trees a horizontal pole of Baranga is fixed and secured with rope made of Mahul (*Bauhinia vahlii*) bark. The whole success of 'Soori Phanda' rests upon selecting only Bargha or Baranga pole 15 inches to 18 inches in girth. Before fixing this pole between the two uprights, it is barked and its cambium layer (living bark) is also removed. The smooth texture of Baranga wood and its sap make it so slippery and soapy that a tiger or panther cannot walk along the pole and reach its middle without falling off. This greasy property of the Bargha pole can be maintained and refreshed for a number of days, by sprinkling water on it in case the tiger does not visit the 'Soori Phanda' on the first or second day. No other species of tree is used for this purpose. The 'kill' is slung from the middle of this horizontal pole with 'Bakkal' (rope made from mahul bark) in such a way that the carcass dangles and swings freely. A twig of green leaves is slipped into the winding portion of the 'bakkal' for camouflage. It may be noted here that tigers or panthers do not reach the middle of the transverse pole, nor do they normally fall off on to the upright spears from this point. This slippery pole is merely a ruse to baffle a tiger or a panther, to rouse its anger and exhaust its patience. Only one out of a hundred tigers or panthers could possibly succeed in reaching the middle of the pole, and even then it would certainly fall on the spear-heads below and meet its death.

4. Spear-head and Shaft

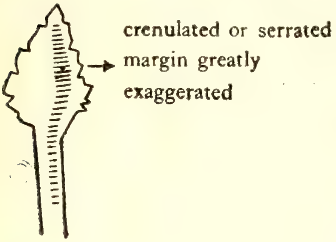
Spear-heads are forged by Agarias from iron ore smelted locally in Bilaspur and Mandla Districts. A Baiga pays 8 annas to 12 annas per spear-head according to its size.

Size of the spear-head.—The total length of a spear-head varies from 8 in. to 10 in. from tip to tip, of which the blade portion is 5 in. to 6 in. long and the hind-end about 3 in. or 4 in. The widest portion of the blade varies from 1½ in. to 2 in. The spear-head is thick in the middle portion of the blade tapering down to a pointed tip and to sharp edges. The thickest portion of the spear-head is situated at the junction of the tail-piece with the widest part of the blade so that the spear-head may not break or buckle up by the weight of a falling object. Baigas call a spear 'Sang' or 'Barchhi'.

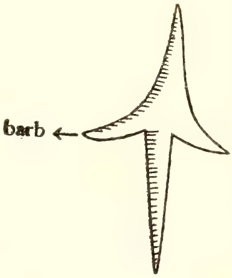


Shape of the blade.—The two edges of the blade of the spear-head are not symmetrical. One edge is prominently convex and the opposite one more or less straight in general outline, (see figure). The Baigas believe that when an impaled animal struggles on a planted spear, the straight edge functions as a lever and the bulging edge cuts deeper into its flesh, and the spear-head thus penetrates deeper and deeper into the victim's body. But the writer has also seen many spear-heads with symmetrical blades being used in 'Soori Phanda'.

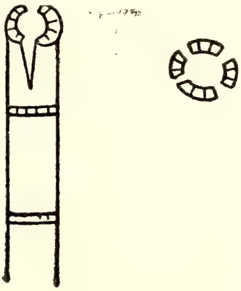
Margin of the blade.—The margin of the blade should not be 'entire' (to use a botanical term) but according to Baigas, the general outline of the edge should be slightly and irregularly crenulated or serrated (figure). They consider that such a jagged margin hastens cutting action when the impaled animal struggles on the spear-head.

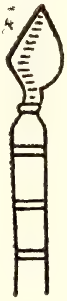


Spear-head in the shape of arrow-head more effective.—A spear-head made in the shape of an arrow-head with 2 barbs, and known as 'Bissar' by the Baigas, is more effective (figure). A tiger killed by 'Soori Phanda' at Bhilki village, in Pandaria Zamindari, in December 1947 carried away three spears of which one was an arrow-headed spear. It extracted one spear and hurled it about 30 feet away from 'Soori Phanda'. The second was found lying just near the trap, but the third arrow-headed-spear remained in the tiger's body. The animal was found dead at a distance of 2½ furlongs from the 'Soori Phanda' on the following day. The Baigas had to cut open the body to retrieve their precious weapon. A tiger or panther cannot cast out an arrow-headed spear from its body nor can a Baiga afford to lose his arrow-headed spear. The writer suggests that if 'Soori Phanda' is conducted under official supervision, such barbed spear-heads should be used.



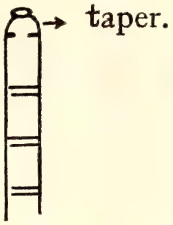
Shaft.—Shaft or handle of the spear is made preferably of well-seasoned bamboo 3 to 5 feet long. The thinner end of the bamboo is split longitudinally into four parts and only upto the first internode as seen in the figure. This end receives the tail-piece of the spear-head. After inserting the tail-piece, the split end of the internode is tightly wound with 'bakkal' (rope made from 'mahul' climber).

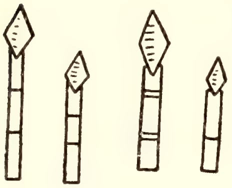




It is essential that the widest part of the spear-head blade should invariably be larger than the diameter of the shaft, i.e. if the diameter of the shaft or bamboo is 1½ in., then the widest part of the spear-head should not be less than 2 in., so that the slit made in flesh of the tiger or panther may permit the shaft to penetrate deeply with ease. The split end of the shaft is tapered at its tip to help in this.

Shaft of unequal length.—The Baigas make two sets of 'Soori' or spears of different lengths. They erect one long and one short spear alternately. The longer set may project 3 to 3½ feet above ground level, the buried portion of the shaft being 1½ to 2 feet. The shorter set may be 2½ to 3 feet above ground and 1½ to 2 feet deep below it. This arrangement is considered important because a falling tiger or panther received on fewer spear points has the probability of deeper penetration. The difference in two sets may be 9 in. to 12 in. It stands to reason that if a tiger or a panther drops on large number of spear points all in the same plane its weight will be distributed over a large bearing surface and consequently the penetration of spear-heads will be more superficial. The object is to impale the tiger on one or two spears only so that the penetration may be deep and prove fatal.

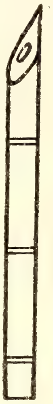




Bamboo spikes as substitute for iron spears. In backward tracts where iron implements are valuable and scarce, the aborigines substitute them with some handy forest product easily obtainable. A typical example is the wooden bell for cattle which one can see in forest areas only.

At the time of a 'Soori Phanda' the villagers may not be able to collect the required number of 'Soori' (spears) normally 16. In such a case they select a dry and strong piece of bamboo, of which one end is pointed like the blade of a spear-head (see figure) and the other firmly planted into the ground.

The writer suggests that a few of these bamboo spikes should always be used along with the iron spears as they harmonise so well with the surrounding objects and would not arouse the tiger's suspicion. Green bamboos should never be used for making these spikes as they are ineffective. When the man-eater of Talaidabra dropped from a height of 15 feet 2 inches on one of these green bamboo spikes, the point of the spike bent over and the man-eater got only a superficial wound in its neck, hardly skin deep. Where bamboos are not available, shafts for spear-heads and spikes are made from 'Khirsari' (*Nyctanthes arbortristis*) poles.



5. Rope made from Mahul (*Bauhinia vahlii*)

Fibre from the mahul climber (*Bauhinia vahlii*) also called 'Mohlain' in Mandla district makes very strong ropes and this is freely used by Baigas in 'Soori Phanda' for the following purposes:

(i) Fastening the two ends of the Bargha pole firmly in the forks of the two selected trees.

(ii) Strapping upright forked supports to selected trees, where natural forked trees of the right kind are not available, and securing the horizontal bar on to these props.

(iii) Tying the four legs of the carcass together for hanging it from the middle of horizontal Bargha or Baranga pole.

6. A SLINGING POLE FOR LIFTING HEAVY 'KILL'

When the kill is a heavy carcass, it is lifted in the following manner:—

The three or four limbs of the carcass are drawn together and tied up with mahul rope. A tiger usually eats the hind leg of its 'kill' first, hence a carcass may have only three legs.

A pole of any species, strong enough to carry the weight of the animal is prepared and inserted between the limbs of the 'kill'. Forked poles of different lengths 8 feet, 10 feet, 12 feet and 15 feet are prepared in sets of two, and with the help of these the carcass is lifted in stages, first say 8 feet, then 10 feet and so on till the desired height of 14 to 15 feet from ground level is gained.

Then one or two men climb up to the transverse Bargha pole by means of a crude ladder propped against it and suspend the 'carcass' from about the middle of it. When this operation is completed, the props and the slinging poles are withdrawn.

Note of warning.—Until the above operation is completed and the men working on the Bargha pole have come down, never set the 'Soori Phanda' on the ground. Otherwise the men working on Bargha pole may get killed, should they accidentally slip and fall.

7. GREEN BRANCHES OR TWIGS FOR CAMOUFLAGE

In order to conceal the rows of spears, the inter-spaces between the upright spear-heads or 'Soori' are planted with branches of green leaves. However, if there be tall grass of the proper height, (3 feet to 4 feet) or bushes in the place where 'Soori Phanda' is set, then the artificial comouflage is not necessary. But a green leaf is stuck on the tip of each spear-head so that this unfamiliar object may not be visible from above.

A branch or two of green leaves is also stuck in the middle of the Bargha pole where the 'kill' is tied with rope. This is done to hide the strong rope with which the 'kill' is attached to the pole.

The kill should swing freely but its position must be such that the head and tail ends always point towards the two supporting trees.

8. 'KHANITA' (ALSO CALLED 'SABAR' BY BAIGAS) OR AN IRON CROW-BAR

To dig holes in the ground for planting about 16 spears upright, an iron crow-bar locally known as 'Khanita' or 'Sabar' is necessary. The holes are 1¼ to 2 feet deep according to the nature of the top-soil.

9. NUMBER OF VILLAGERS REQUIRED

When the 'kill' is heavy, about 30 to 40 men are required to lift it by means of props to a height of 15 feet from ground level. It is not difficult to collect this number for 'Soori Phanda'. Villagers are generally willing to help in the destruction of a cattle-lifter or a man-eater.

Any portable mechanical equipment which can easily lift a heavy 'kill', upto 15 feet off the ground, would be a great improvement. Owing to the labour and trouble involved in the crude devices usually employed, 'Soori Phanda' is now practised rather sparingly.

How to set 'Soori Phanda'

In the proceeding section all parts of 'Soori Phanda' are described in detail. The operation of the 'Soori Phanda' is described here and illustrated by a rough diagrammatic sketch.

Having located the 'kill' of a cattle-lifter, the first step is to search for the possibility of other 'kills' in the same locality. When a tiger can get his food on the ground he is naturally not going to take the trouble to climb the tree and oblige the 'Soori Phanda' trappers. In the Baiga demonstration carried out for the benefit of the writer the cattle-lifter was given no inducement to climb the tree, as the Baigas had neglected to remove the two other kills in the same locality.

The second step is to find two ideal trees, forking at a height of about 15 feet from the ground and as close to the 'kill' as possible. If such are not available it is best to bring from a distance two props with forks. If the ground between the two selected trees supports tall grass or bushes in the right position, do not clear the ground. If not, then branches of green leaves for camouflage between the spears may be used. Stick a green leaf or two on the tip of every spear-head; camouflage the rope tying the kill with the Bargha pole. Take a pole of Bargha or Baranga (*Kydia calycina*) 15 to 18 inches in girth and slightly longer than the distance between the two selected trees. This should be barked and the cambium layer removed. Fix the pole horizontally in the fork of the two trees or props by means of 'bakkal' (rope made out of mahul fibre). It would be unfortunate if the special species is not found for the horizontal pole within a reasonable distance in the forest, but perhaps a pole of some other species, well coated with grease or fat may serve equally.

With the help of a slinging pole and a set of forked props, raise the 'kill' until it reaches the level of Bargha pole. One or two men are required to climb up to its level with the help of a crude ladder in order to suspend the 'kill' from its middle. The slinging pole and props supporting it should be withdrawn after this and the men asked to come down.

Just below the dangling 'kill' arrange to plant about 16 spears in the ground in a space about 4 feet × 4 feet. This spot is irregular in shape and the spears are neither equidistant from each other nor are they arranged in regular lines or rows. The Baigas look up to the dangling kill while fixing position for digging holes for erecting each spear. As mentioned previously, spear-shafts are of two different sizes the shorter and longer ones being planted alternately in the ground in holes 15 in. to 24 in. deep just below the carcass. The spears are firmly fixed with their tips pointing skyward.

If the head and neck of the kill hangs too close to the ground, it must be drawn up with ropes or removed because a tiger is tempted to jump and grab at the nearest part of the 'kill' from the ground and in doing so he gets the shortest drop on the spears—merely wounding the animal. The higher the drop, the deeper the penetration of spears is what must be kept in view. The minimum drop should be about 8 feet.

Camouflaging is the last operation. After this the men return to their village. When a tiger visits the place and finds its 'kill' hanging on a pole, he surveys the neighbourhood with great caution. When fully satisfied of the coast being clear, he climbs one of the trees supporting the pole. He tries to approach the 'kill' by walking on the pole, and is baffled and irritated when he finds it slippery. Instinctively he clings to the tree with one of his forepaws, while with the other forepaw he either tries to grab the 'kill' or strike with force so as to bring it down to the ground. Whether the action is for grabbing or for striking down, it is difficult to say but in either case, the hanging 'kill' swings away from the tiger. In his attempts the tiger soon over-reaches himself, loses his balance and drops on the labyrinth of spears below like a sack of potatoes. Being heavy and powerful animals, tigers often carry away spears some distance from the 'Soori Phanda' but are usually found dead within a few hundred yards. Panthers succumb within 30 to 60 yards and are sometimes even pinned down where they drop.

Near Daldal Forest Village, a panther which apparently succeeded in reaching the middle of Bargha pole dropped plumb on his bottom. A spear entered his rectum and ploughed right through his body. He was impaled in this position and his rampant dead body was found on the following day. The Baigas were in roars of laughter while describing the fate of this panther!

There are no authenticated instances of man-eaters being destroyed by 'Soori Phanda'. The reason for this is not far to seek. When a person dies a violent death, the dead body is not interred unless a responsible police officer has examined the same and a police panchnama held. On rare occasions there are cases of actual murder and the murderer tries to pass it off as death due to attack of a wild animal. Therefore police officers have to take extra precautions and obtain clear evidence that the victim was actually so killed. These formalities react on the mind of aborigines, and when a person is killed by a man-eater, anxiety to preserve the body is uppermost in their mind. When the man-eater of Talaidabra forest village killed Jungi Bhootia, the villagers searched for his dead body and when it was recovered, they strapped it on a branch of a tree 11 feet above the ground. This was done not for baiting 'Soori Phanda' but to preserve the body until it was examined by a police party. But the man-eater climbed the tree, chewed the 'bakkal' ropes, brought the body down and left nothing of Jungi's remains, except a few bones for identification by a police official.

MAN-EATERS EASIER TO TRAP THAN CATTLE-LIFTERS

Man-eaters are mostly wounded or disabled animals. They secure their unnatural food with great difficulty, and having secured their prey, they are desperate. Maiku Gond, a forest villager of Bindawal, Bilaspur Division, was killed by the Talaidabra man-eater at 9 a.m. on 10th April 1949. Villagers of Bindawal, with the help of other villagers recovered his body within a few hours, giving no time to the man-eater for sufficient feed. Maiku's body was strapped to two standing trees 15 feet above ground level. Not being expert in setting 'Soori Phanda', they fixed spears and spikes of green bamboos below the body. The man-eating tigress climbed the tree the same night, and due to sagging and swinging bamboo poles, she lost her balance and fell on a green bamboo spike, and escaped with a superficial wound in the neck. On 12th April Maiku's body was brought down at the suggestion of the Range Officer, Kota, as bait for the man-eater. The tigress visited the place at night, dragged the body about 300 yards and ate a portion of it. On 13th April a beat was organised but the man-eater did not turn up. However, the Range Officer sat up over the kill the same night and shot the animal at about 8 p.m. in the act of holding the prey in her jaws. This instance shows that the man-eater visited and revisited her human kill four times, and she did not leave the locality for 3½ days (84 hours).

There is a belief that a man-eater becomes habitually addicted to human flesh. The writer, therefore, strongly advocates the use of 'Soori Phanda' for man-eaters in the same manner as employed for cattle-lifters, and would suggest that police officers should not insist on examination of the corpse until the negative result of 'Soori Phanda' becomes known. The corpse of a human victim is easier to handle than a bovine carcass and ensures better success if used as bait for a man-eater.

Whether the tips of the spear-heads are coated with poison or not, is a moot point, and Baigas speak on this subject with mental reservation. The writer feels the application of poison is perfectly justified and legitimate when 'Soori Phanda' is set for a man-eater.

An Apology for 'an Ignoble death for a Noble Animal'?

Tradition and the finer points of sportsmanship perhaps demand that such a noble animal as the tiger—the king of the forest—should not end his life by such an ignoble death.

As long as a tiger is a game-killer, he is a gentleman; he never interferes with man or his property. And so long as a tiger remains a gentleman he has our admiration and respect. But cattle-lifters and man-eaters adopt new ways of life, (perhaps compelled to do so by man himself) which make them a source of danger and menace to man and his live-stock. Such creatures are in no way better than 'Goondas' among human society, and surely nobody feels any compunction about how a Goonda ends his life.

The writer, therefore, feels no qualms of conscience for the method suggested for the destruction of cattle-lifters and man-eaters. To the tiger-shooting enthusiast, the writer owes no apology for sending the cattle-lifter and man-eater to the scaffold of 'Soori Phanda' to put an end to their nefarious career.

Acknowledgement

The writer of this article is indebted to Shri C. E. Hewetson, I.F.S., O.B.E., Officiating Conservator of Forests, Eastern Circle,

Central Provinces for going through the draft and making useful and necessary modifications. In fact, his words of encouragement induced the writer to prepare this article—a task beyond the province of a practical forester.

Lt.-Col. R. W. Burton, I.A. (Retd.) to whom this article was sent by the editors, comments as follows:—

'There is much to interest members in Mr. Daver's article.

In various parts of the world primitive peoples have evolved a number of ingenious ways of destroying animals for one reason or another—for food, for clothing, for gain, and to be rid of pests. This 'greasy pole' method now described is somewhat elaborate and would, as suggested by Mr. Hewetson in his foreword, almost certainly fail in case of most tigers, whether those 'educated' through experience or naturally wary. Only in quite exceptional circumstances would it be likely to succeed.

When beyond Myitkyina in the Upper Irrawaddy country in 1931 the writer came to know that the people of the 'Triangle', as the area between the Mali and 'Nmai' rivers is termed, destroy tigers by a 'spiked bamboo' method. When it is noticed that a tiger has the habit of using one of the cane and bamboo bridges he is given a 'hangman's drop' of some 40 feet more or less on to spiked bamboos fixed in the ravine bed beneath the place where a few slats have been suitably adjusted for the occasion. The fall is almost always fatal and a somewhat ignominious end to a splendid beast not particularly harmful to the human beings of those parts.

A device of strewing leaves covered with sticky substance was used in the days of the Emperor Akbar for dealing with tigers which it was desired to kill or capture. 'Sport in Indian Art' by Col. T. H. Hendley, C.I.E. in the *Journal of Indian Art and Industry,* (1915)., and *J.B.N.H.S.* Vol. 25. pp. 491 and 753 may be seen in this regard. On p. 753 it is recorded that the device had survived up to the year 1890-91 in the Sambalpur forests of the Chattisgarh division of the Central Provinces. This might be a more effective and less troublesome method than the 'Soori Phanda' of the Baigas of the Maikal Hills; that is to say if it is considered necessary to increase the destruction of tigers. The birdlime is spread on broad leaves around the kill or along a path and the tiger struggles and rolls about in order to free it from his paws, claws and body. The leaves stick to the face in such number as to blind the animal which can be approached and killed or netted while in this helpless and worried state.

It may be of interest to remark that a birdlime method for killing sloth bears was in use a hundred years ago, and may be even at the present day, by the people at the foot of the hills in the Tinnevelly District of South India as related by General E. F. Burton in his book, 'An Indian Olio' (1890). Powerful Poligar dogs tackle the bear, and the hunters, armed with long spears cross-barred close to the two-edged blades run to the spot where two or three of the party having ten foot bamboos smeared with birdlime at the ends dash up on either side, poke the bear in the ribs and adroitly twist the ends in the long hair thus holding the animal fast on either flank for the spearmen to complete the kill by repeated spear thrusts.

Man-eaters and cattle-lifters.

'With the departure of shikar-minded people from India the cattle-lifters have increased.' It is true that an increase of cattle killing by tigers has taken place since August 1947 in far apart areas, but the cause of the increase may be not so much the departure of shikar-minded people as the very great increased lawless killing of deer by the people themselves. That, in all probability, is the main reason for increase of cattle-lifting by tigers and to some extent of man-eaters also. When the balance of nature between the larger carnivora and their natural prey is unduly disturbed, tigers are bound to increasingly turn upon the cattle, and learn also to kill the herdsmen who continually drive them off their kills.

Heavy economic loss to cattle owners.

It may possibly be more pecuniarily economic to the Government to restore rewards for the destruction of tigers, but the long view loss to the Government and the people of India through the immense destruction of wild life which is proceeding almost unchecked in most parts of the country is incalculable. It is possible that through the giving of rewards and other methods of destroying tigers, were a campaign against them to be instituted, their population would be reduced to vanishing point. It has indeed taken place in many areas to the knowledge of the writer during his sixty years experience of this country. When the unchecked slaughter of deer has resulted in the disappearance of these animals, and the tigers also have gone, it will be seen whether the people of the forests and their vicinity are better off or worse off, for the pig and other crop raiders will remain. All interested in these matters are asked to read and study the several Wild Life preservation articles by the present writer and others in the Society's Journals:— e.g. Vol. 47, pp. 778-784, Vol. 47, pp. 602-622, Vol. 48, pp, 283-287, Vol. 48, pp. 290-299, Vol. 48 pp. 588-591.

Increase of wild dogs.

As, in the opinion of the writer, the restoration of tiger rewards will be a retrograde step, so—it has been found—the discontinuance in some areas of rewards for destruction of wild dogs has been proved a great mistake. As has been remarked in the literature referred to above, rewards for destruction of wild dogs should be substantial and continually in force where these pests exist. Wild life preservation would be considerably assisted by their extinction.

Increase of gun licences and decrease of herbivora.

This has been going on for a number of years, and for the past two years the deer population is being in many areas reduced to vanishing point. The time has arrived when a complete embargo for a period of years should be enforced as to killing of deer throughout the country; also all trapping of game animals and birds should be ended.

The contents of Mr. Daver's article once again emphasise the need for a Wild Life organisation in all Provinces and States.'

THE TROPIC-BIRDS OCCURRING IN THE INDIAN OCEAN AND ADJACENT SEAS

BY

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(*Raffles Museum, Singapore*)

(*With three plates*)

The tropic-birds form a small but interesting group of tropical sea birds. In general appearance and the manner of their flight they are not unlike large, heavily-built terns. They differ most markedly in the shape of the tail, which is cuneiform and in the adult has the centre pair of feathers much elongated. When fully developed these feathers are about as long as, or slightly longer than, the head and body of the bird together. When it is in the air they trail conspicuously but gracefully behind it, and provide a field character by which a normal adult of the group can always be recognised. The tropic-birds have short, weak legs, and can neither walk nor stand properly. They always rest with their bellies on the ground, and when moving forwards collapse on their breasts between each step. When frightened or otherwise in a hurry they help themselves along with the wings and bill, as some of the penguins do. A bird that is approached on its nest makes little attempt to escape, but remains, screaming harshly, and tries to defend itself with short, vicious stabs of its beak. The feet are webbed, and they swim well. Their bodies are compact, the neck short and the bill stout and pointed.

The moult of the two central tail feathers is abnormal in that they are not shed and replaced synchronously at the end of the breeding season. Specimens of the Redtailed Tropic-bird usually have one old, fully developed central feather, and one shorter new one, still partly in sheath at its base. The same arrangement may be found in the other two species, or these birds may have two growing feathers, of which one is much older and longer than the other. It seems probable that in the Redtailed bird one feather is lost at each annual moult and the new one takes about a year to grow to its full length. The other feather is then shed at the next general moult. Presumably the same alternation occurs in the whitetailed birds but here it is spaced less regularly, the old feather being dropped as soon as the new feather is full grown, without reference to the time of the annual moult. Dr. A. Wetmore (1914: 497) describes a somewhat similar condition in the Helmeted Hornbill, *Rhinoplax vigil* (Forst.). It is probable, as Chasen (1933: 73-4) suggests, that this system of alternate moulting occurs in some of the other birds which possess a single pair of elongated centre feathers, since it presents the only mechanism whereby there can always be at least one feather of full, or almost full, length.

With one exception, which is noted below, the adults are largely a lovely satiny white with a black crescent running across the eye and a black bar on the wing. The white of the neck and underparts may be suffused with a roseate or a golden yellow bloom, depending on the species, but the colour is fugitive and varies considerably in intensity with the condition of the feathering. In the field the adults can be separated by the colouring of the bill and the form and colour of the elongated tail feathers. Juveniles lack the elongated centre tail feathers, and have the feathers of the upperparts and flanks marked with crescentic black bars. They cannot be distinguished specifically in the field, though no great difficulty should be experienced in identifying a bird in the hand.

As their name suggests, these birds are normally confined to the warmer seas and oceans. They are not very plentiful, but they are found on a number of small, isolated islands in or near the tropical zone all round the world. Murphy (1936, (2): 796) draws attention to an interesting point in regard to their distribution in the Atlantic and Pacific Oceans. The eastern sides of the great continental masses are washed by warm currents flowing out towards the poles, while the western sides have cool currents flowing in towards the equator. The spread of the warmer waters is therefore much wider in the western portions of these oceans than it is in the eastern. Similarly the known ranges of the tropic-birds there are more or less wedge-shaped. To some extent the picture is obscured by the fact that there are more suitable islands in or near the tropics in the western halves of the two areas than there are in the eastern. Nevertheless it is significant that in the Atlantic tropic-birds breed only from St. Helena (16°S. lat.) to the Cape Verde Islands (15-17°N. lat.) on the east side, stopping short of Tenerife, the Canaries and Madeira, while on the west they nest from the Abrolhos Islets (18°S. lat.) to the Bermudas (32°N. lat.). In the Pacific they occur only from the coast of Ecuador north to Panama in the east, while in the west they nest from the Kermadecs and Lord Howe (31°S. lat.) to the Bonin Islands (27°N. lat.). In the Indian Ocean the temperature spread is modified considerably by the great land mass of the continent of Asia which forms its northern boundary. The only cold inflow is along the southern portion of the west coast of Australia, turning west short of the north-west coastal region. Here on the east side of the ocean we find tropic-birds nesting in suitable localities from nearly 29°S. lat. on the latter coast north to (in all probability) the southern portion of the Bay of Bengal, while in the west they can only range from Réunion (21°S. lat.) to the Persian Gulf, just north of the Tropic of Cancer. Accordingly, though they still keep approximately within the area bounded by the 64° mean isotherm, they appear to be spread much more evenly over the Indian Ocean than over the Atlantic or Pacific.

The tropic-birds differ from the majority of the more conspicuous tropical sea birds in that some individuals at least normally leave the nesting grounds outside the breeding season and range widely over the open sea. Bennett (1860: 89) records several specimens of the Short-tailed Tropic-bird from a point almost midway between the Cape Verde Islands and the Bermudas, nearly 1,000 miles from the nearest land. The same species has also been seen about halfway between the Laccadives and Socotra, on the border of the Arabian Sea. On these occasions tropic-birds are usually met with singly or in pairs, and they show a peculiar interest in passing ships. They generally fly high above the water, and when they see a vessel turn towards it and circle round several times, calling out harshly as they do so. Then, after a brief, raucous inspection they make off again. It would seem that they do not normally follow a boat for any length of time, and it is certainly most unusual for them to attempt to feed in the wake. Their short inspection is, however, generally sufficiently conspicuous for them to be noted and identified. In the Indian Ocean they are most likely to be encountered in the north-west corner, from about the region of the Maldives, Laccadives and Seychelles up towards the Arabian Sea.

The tropic-birds feed almost entirely on flying fish and squids. These are taken from near the surface of the sea by diving from the air. They usually drop down, with half-folded wings, from a height of about 20-60 feet. They make a considerable splash as they enter the water, but they return quickly to the surface. Often they seem to be back in the air again before the spray raised by their immersion has settled fully. The young birds are fed by regurgitation.

The tropic-birds lay only one egg to a clutch. The choice of nesting place, as shown below, varies considerably, but apparently in all cases they make use of a hole or a crevice, or select a spot where a bush or rock gives them partial shelter. They seem, in fact, to have a marked predilection for a protected or even an enclosed and confined site, in strong contrast to the great majority of the world's sea birds. A detailed account of one species, the Redtailed Tropic-bird, has already been given by the present writer in this journal (1949*c* : 230-33). Here one would merely stress an interesting point which seems to be common to the group. The youngsters are abandoned by their parents when they are fully grown. They then make for the open water alone, and do not normally return to the vicinity of the nesting grounds until they have acquired the complete adult plumage. In spite of this there are very few records of juvenile birds observed or taken at sea.

Three species are known :

The Short-tailed Tropic-bird, *Phaëthon æthereus* Linn.
The Long-tailed Tropic-bird, *Phaëthon lepturus* Daud.
The Redtailed Tropic-bird, *Phaëthon rubricauda* Bodd.

all of which are represented in the Indian Ocean. In the following notes an attempt is made to summarise what is known of the distribution of these birds in our area, with the inclusion of some unpublished data. Consideration is also given to the information available on breeding habits and seasons. In some respects the volume of published data is meagre. For this reason a brief statement of the essential characteristics of each species, as seen on the wing, has been added at the end of the section dealing with it.

Phaëthon aethereus Linn. : *Short-tailed Tropic-bird.*

Only one subspecies is found in our area, *P. æthereus indicus* Hume (type locality, the Mekran coast, Baluchistan).

This species has a restricted breeding range in the Indian Ocean. The race *indicus* apparently prefers small, isolated, fairly barren islands for its nesting sites. It is known principally from the Arabian Sea and adjacent waters, in parts of which it is not uncommon. The only other records from our area are old visual notes from the Bay of Bengal and an immature bird taken by Cantor in the Strait of Malacca, all of which are seemingly based on strays. The only breeding site known outside our area is in the Paracel group in the South China Sea, about 165 miles from the coast of Annam (Delacour & Jabouille, 1931 (1): 31). In spite of the presence of this latter colony the only published record for Malaysian waters is Cantor's specimen mentioned above.

Holdsworth's visual records of *P. rubricauda* off the coast of Ceylon (1872: 482) must certainly be ascribed to this bird, this constitutes the southerly limit of its known spread in this region. Betts (1939: 386) reports two birds seen between the northern Laccadives and the mainland, also in February. He saw none during his stay in the archipelago, and it is of interest to note that there are apparently no records of any tropic-bird from islands in the Laccadive group. Hume (1876: 427 & 481) lists a specimen taken about 30 miles from the Cherbaniani atoll at the north end of the Laccadives in February. He also says that it is fairly common all up the west coast of India in a zone between about 7 and 30 miles of the shore. Further north Butler (1877: 285) reports three or four birds seen between the Gulf of Cutch and Karachi in March. Hume (1873: 147) says that he saw a number of birds off Ormara headland on the Mekran coast, of which he collected six (♂♂ 5, ♀ 1). Ticehurst (1923*a*: 461) also says that it is apparently fairly common at times off the coast of Sind and more particularly off the Mekran coast. Butler (1877: 302) mentions it from between Ormara and Gwadar in this area, and says that it is not uncommon up the Gulf of Oman. It would seem, in fact, that the Short-tailed Tropic-bird is fairly common in off-shore waters from the Gulf of Oman eastwards along the Mekran coast to Sind, and then, probably in decreasing numbers, southwards off the west coast of peninsular India to the northern limits of the Laccadives, or even as far as Ceylon. Few breeding sites are known from this region. Ticehurst *et al.* (1925: 725) say that it probably nests on the Great and Little Quoins, two rocky islets near the headland of Oman, but no eggs or fledglings appear to have been found there. Seemingly the only authentic specimens taken so far have come from the little island of Nabi-u-Tanb, at the eastern end of the Persian Gulf. It lies 7 miles south-west of the lighthouse island of Tanb, and is described as one mile long and three-quarters of a mile broad, with a rocky hill 116 feet high; it is said to be barren, uninhabited and without water. Young and old birds and a year-old egg were taken in the first week of April, 1921, and a single egg, almost ready to hatch, on 24 March 1923 (Ticehurst *et al.*, 1925: 729-30).[1]

There do not appear to be any definite records for the Hadramaut coast of Arabia, but this bird is fairly well known, and several breeding grounds have been located in the Gulf of Aden, at the southern end of the Red Sea and off the Somali coast. North (1946: 490-1) found two nests with young birds almost ready to fly on Mait Island, in the Gulf of Aden, at the end of November. Jones (1946: 228-31) discovered birds breeding on the Geziret Saba, in the Bab-el-Mandeb Straits, about 9 miles south of Perim, in August. Von Heuglin (quoted in North *loc. cit.*) says that it breeds (?lays) in the Dahlak Archipelago, in the Red Sea off Massawa, in June and July. Bulman (1944: 480-92) makes no mention of this species in his account of the birds of Safaga, a small island further up the Red Sea and only 235 miles south of Suez. Archer and Godman (1937 (1): 19-20) say that it may be found as far north as Tor on the Sinai peninsula, but it seems that the Dahlak Archipelago is the most northerly recorded breeding ground in this area. These authors also say that the Short-tailed Tropic-bird is known from Danakil Bay, about Jebel Saqur and Annan, about Bab-el-Mandeb, on Bur da Rebschi, and about Sokotra and Guardafui. I have myself twice seen solitary adults at sea in the latter region, once about 10 miles north of Sokotra, in September, and the other about halfway between Aden and Sokotra, in February.

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[1] In addition to these two eggs Ticehurst *et al.* refer to another egg in the Cox-Cheesman collection taken on Nabi-u-Tanb on 23 April 1923, and Stuart Baker (1929: 291) to an egg taken by Major Pitman from a crevice on an unspecified barren island in the Persian Gulf in April 1916, and one collected from the same neighbourhood by Irvine in 1898. In none of these cases was the parent bird identified, but it seems almost certain, as Stuart Baker says, that it was ***P.a. indicus***.

The records from the Bay of Bengal are less satisfactory, and no direct evidence has yet been brought forward of breeding in this area. Baker (1929: 291) makes no reference to its occurrence here, and Peters (1931 : 78) gives its range only as the northern Indian Ocean, said to breed on islands in the Persian Gulf and the Dahlak Islands. Hume (1874: 323) says that he had been told that this bird was often seen on passages to and from the Andaman Islands, especially in the neighbourhood of the Cocos Islands (north of the Andamans proper), but he did not encounter it himself on his visit to the group. He also mentions four birds which Davison is said to have met with in the Bay of Bengal in lat. 9°N. (Hume, 1877: 303). Later Hume and Davison (1878: 493) say that Davison met with this species almost opposite the southernmost point of Tenasserim and again off Cape Negrais. Are these the birds to which Hume referred in his earlier paper? It is possible that they are. It is certainly significant that there are no later records and no other citations of *P.a. indicus* from this region. The birds may have been strays from the Paracel colony, or they may possibly have been immature birds of one of the other species.

There is one formal record for the Strait of Malacca; the last reference to the occurrence of these birds in our area. It is an example taken by Cantor, and now in the British Museum. It is usually assumed to have been obtained near Penang, but there is no indication of this in the earlier publications of the record. Sharpe and Ogilvie-Grant (1898: 459) list the bird as an adult, but J. D. Macdonald (*in litt.*) tells me that it is an immature bird, and therefore one of the few records of an immature bird taken at sea. On the evidence available at present it must be assumed to be a stray from the Paracel colony. Pulau Perak, a barren outcrop about 70 miles west of Penang Island, is a likely nesting place for this species, but a search of the island early in April showed no indication of tropic-birds breeding there (see Gibson-Hill, 1950).

It is of interest to note, as mentioned above, that *indicus* apparently prefers barren or relatively barren islands as breeding sites. This point is significant in relation to the only two parts of the Indian Ocean where it is not uncommon, and is known to be nesting—the eastern end of the Persian Gulf and along the Mekran coast to Sind, and the region round the south end of the Red Sea and the Gulf of Aden. At all the recorded sites the birds appear to have been making use of crevices or fissures in bare rock faces or among boulders. In addition only a few birds have been found at each place. von Heuglin writes of small and thinly populated colonies, with the nests themselves in narrow deep clefts in the rock, in fissures, or under large loose boulders. The entrances to these crannies are often so narrow and low that it seemed that the bird itself would hardly have room to pass. Here the female lays a single egg on the bare soil, on blown sand, or on the bare rock. The holes I investigated extended inwards for three or four feet, and the actual nesting-site was generally behind a projecting angle of the rock so that it could not possibly be seen from the outside . . .' (quoted in Archer & Godman, 1937 (1): 21-22). Ticehurst *et al.* (*loc. cit.*) say that there is a little scrub on Nabi-u-Tanb but no trees; 'at the base of the sea cliffs are many water-worn fissures, mere cracks at the top and eight inches to two feet wide at the base and going in some six feet, some ending in an enlarged chamber; it was in these fissures that the Tropic Birds were breeding.' North (*loc. cit.*) says that Mait Island is completely devoid of vegetation, and has no fresh water except after rain. He found one nest in a crevice under a boulder and a second in a hole in a cliff-face. Jones (*loc. cit.*) gives a rather similar account of two nests from Geziret Saba.

The Short-tailed Tropic-bird is midway in size between the other two species, but with the elongated centre tail feathers appreciably shorter. Baker (1929: 291-3) gives the following measurements in mm. for adult birds:

—	Wing flat	Exposed culmen	Tarsus	Central tail. Longest feather
P. a. indicus	281–301	55–60	25–28	215–301
P. l. lepturus	252–282	44–51	21–23	{ to 575, av. c. 450
P. r. rubricauda ...	330–339	66–69	30–33	360–428

In the Indian Ocean the adult can always be identified by the combination of white centre tail feathers and a red or orange-red bill. The races of the Longtailed Tropic-bird occurring here have a yellow or yellowish bill at all times, while in the Redtailed Tropic-bird the elongated centre tail feathers have black shafts and thin, attenuated red vanes. In addition the upper parts in the present bird are narrowly barred with black, an instance of the retention of a juvenile characteristic. Too much reliance should not be placed on this feature in the field here, however, as it brings in the possibility of a late immature example of one of the other two species being taken for the Short-tailed Tropic-bird. The immature bird resembles the adult except that the centre tail feathers are not appreciably longer than those on either side of them, the bill is yellowish not red and the markings on the dorsal surface are broader; on the head they almost form a black occipital crescent. The immature bird can scarcely be differentiated from the young of the other two species in the field. In the hand first juvenile birds can be separated on the following points, in addition to differences of size (as above) and the colouring of the soft parts. The descriptions of the markings should be taken as general indications of the patterns. There are apparently minor individual variations, even between birds of the same age, and probably small subspecific differences, but these are not sufficient to confuse the diagnosis.

——	*P. a. indicus*[1]	*P. lepturus*	*P. rubricauda*
Outer primaries.	Black, with a broad white border to the inner web.	Shaft and outer web black; tip and inner web white.	White, with a narrow black shaft-stripe broadening at the tip.
Inner primaries.	White with very dark gray shaft-stripe.	White with shaft black.	White, with black shaft and sub-apical spot.
Outer secondaries.	White, with shaft blackish.	White, with base of shaft black.	White, with shaft black.
Inner secondaries.	Dark grey bordered with white.	White with black half crescents on outer web.	Black, with irregular white border.
Rectrices ...	7 pairs. White, centre pair with black tips.	6 pairs. White, with black shafts and sometimes sub-apical spots.	8 pairs. White, with black shafts and small sub-apical spots.

Phaëthon lepturus Daud.: *Longtailed Tropic-bird.*

Two races of this bird are known from our area. The typical race (type locality, Mauritius) which occurs in suitable localities over the greater part of it, and the Golden Longtailed Tropic-bird, *P. lepturus fulvus* Brandt (type locality, Christmas Island) which is known only from the neighbourhood of Christmas Island, 180 miles south of Java Head.

The typical race of the Longtailed Tropic-bird breeds at a number of places in the Indian Ocean near or south of the equator. It is usually found on oceanic islands with a fairly thick cover of trees or palms, and is not known authentically from the hotter and more barren localities round the Red Sea, the Persian Gulf and the Mekran coast.[1] In the western part of the Indian Ocean it nests in some numbers in the Mascarene, Seychelle and Maldive groups and is fairly common in their neighbourhood. Legge (1880 (2): 1174) mentions a dead bird picked up on the Galle face, on the Ceylon coast, in 1870. There is also a record of a bird killed on Ross Island in the Andamans (Hume, 1874: 323), of one taken on the south coast of Pegu, near the mouth of the Bassein estuary (Oates, 1883: 225), and of a straggler collected from the Barak River, near Dilkushah in north-east Cachar, about 170 miles from the sea (Hume, 1888-9: 351). Although this bird is always said to occur in the Andamans[2] these records, which are almost certainly attributable to strays, are the only authentic formal records for the northern Indian Ocean outside the Maldive area. The only established nesting grounds outside the Mascarene—Seychelles—Maldive region are the Cocos-Keeling Islands, where there is a small colony which comprised about 10-15 pairs in 1941 (Gibson-Hill, 1949*b*: 230), and Diego Garcia (Chagos) where Gardiner found a single pair in 1905 (1907: 110). The typical race, *P.l. lepturus,* is not known from localities outside the Indian Ocean.

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[1] Not examined. Data from Ticehurst (1923*b* : 71) and Baker (1929 : 291). *P. lepturus* based on *P. l. fulvus* (Christmas I.). *P. rubricauda* on *P. r. westralis* (Christmas I.).

In the Mascarene islands this bird is known to breed on Mauritius and Rodriguez (Baker, 1929: 293). It almost certainly formerly bred on Réunion, and may still be present there; the British Museum collection contains several skins from this locality (Sharpe & Ogilvie-Grant, 1898: 455). Vesey-Fitzgerald (1941: 530) says that this bird is common around all the rocky islands of the Seychelles Archipelago, and apparently nesting widely. Betts (1940: 502) says that

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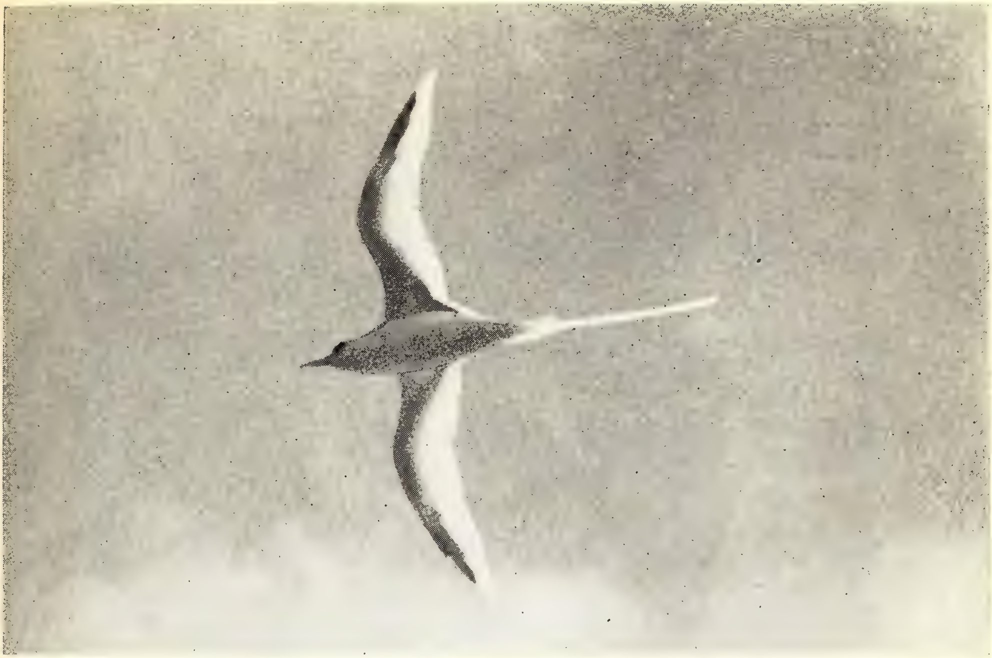
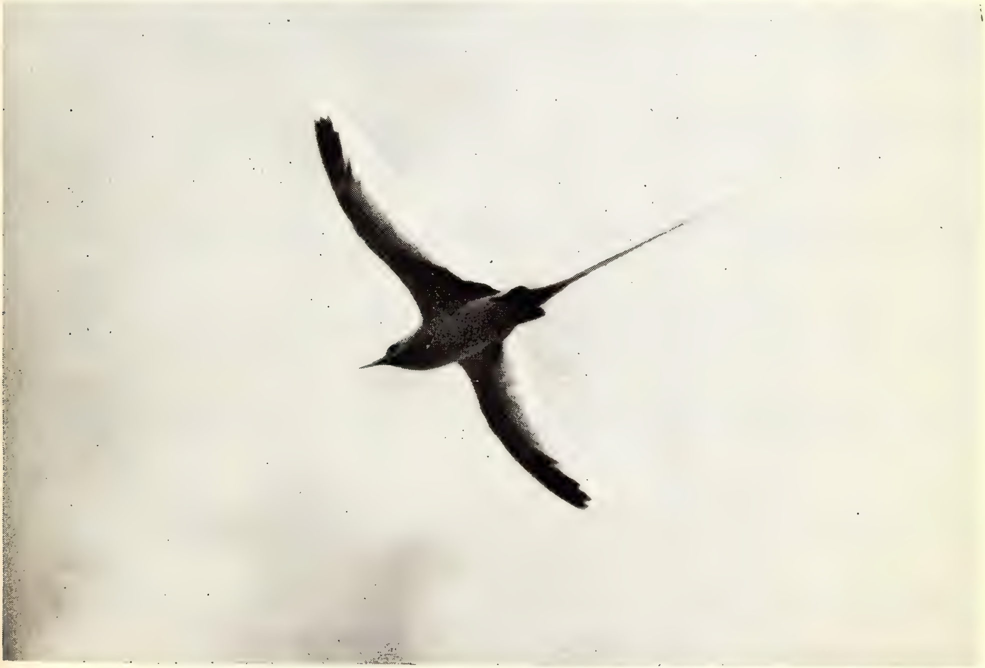
[1] Stuart Baker (1929: 293) gives the distribution of this bird as the 'Red Sea and Persian Gulf, over the whole of the Indian Ocean', but the first part of this statement cannot be accepted. There are no authentic records of *lepturus* from the northern part of the Arabian Sea and adjacent waters. Hume (1876: 481-2) writing of *indicus* says 'This is the only species of *Phaëthon* that I have seen or known to occur in the Indian Ocean anywhere near our Indian coasts or in the Gulf of Oman, or the Persian Gulf. Both *flavirostris* (=*lepturus*) and *rubricauda* have, I know, occurred in the Bay of Bengal and about the Andamans and Nicobars, but I have neither seen nor heard of either of these in the localities above alluded to.' This still holds good. Archer & Godman (1937 (1): 20) say that *lepturus* might at any time find its way into the Gulf of Aden 'and any definite record of its occurrence in the Gulf of Aden or the Red Sea would be of the utmost interest.' Personally I think it most unlikely that a true *lepturus* would get into these warmer regions, but I agree fully that a definite record of its occurrence would be of the utmost interest. All the supposed records that I have been able to trace are of the quality of those of Major Phillips, who nearly saw five of the four storm petrels authentically known from the northern Indian Ocean in one voyage from Suez to Karachi! He gives several records of *P. l. lepturus* from the southern end of the Red Sea, including '15-45 *Hours.* Tropic bird, with red-bill and long white tail feathers flew close across our bows, giving an excellent view—definitely the White Tropic Bird (*P. l. lepturus*); a beautiful bird.' (Phillips. 1947: 608). A red bill and long white tail feathers: definitely *P. æthereus indicus,* a very beautiful bird!

[2] Accepting general statements such as those of Hume (1876: 481) and Smythies (1940: 445), together with Kloss's inclusion of this bird in his list of the avifauna of the Andamans (1903: 330), I have myself helped to perpetuate the error, and in a note in my Checklist of the birds of Malaya (1949*d*: 16) I give the Andaman Islands as a breeding ground of *P. l. lepturus.* Now, on a fuller examination of the records from the Bay of Bengal, I am satisfied that there is not yet any evidence that it actually nests in this region.

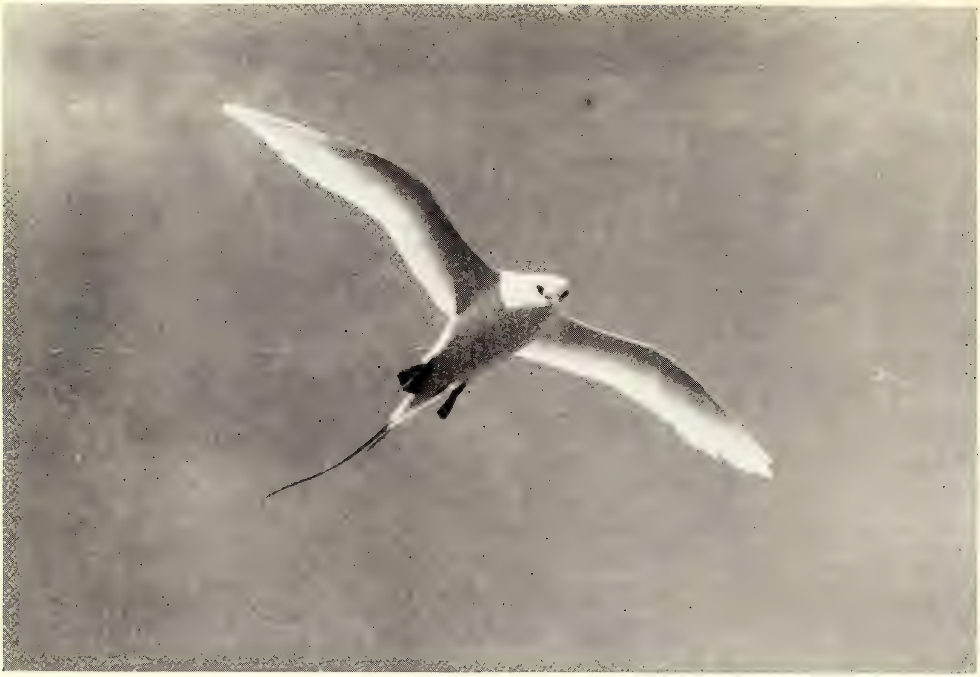


An adult of the Long-tailed Tropic-bird—*Phæton l. lepturus*, in flight, taken at sea 200 miles east of the Cocos-Keeling Islands.

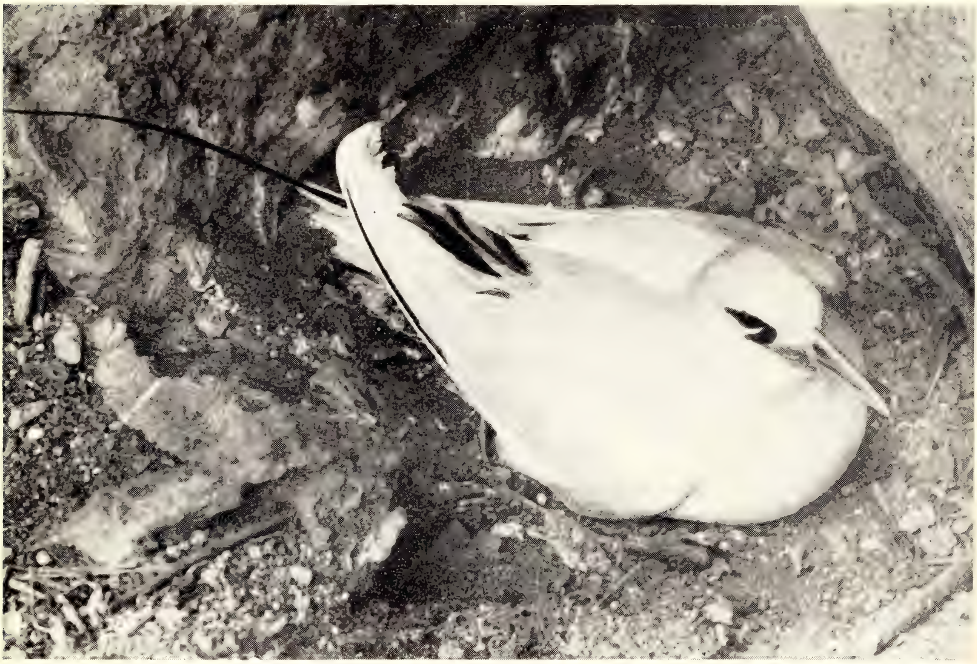


Photos *C. A. Gibson-Hill*

An adult of the Christmas Island Long-tailed Tropic-bird—*P. lepturus fulvus*, in flight.



An adult of the Red-tailed Tropic-bird—*P. rubricauda westralis,* in flight.



Photos *C. A. Gibson-Hill*

A Red-tailed Tropic-bird—*P. rubricauda westralis,* on its nest in a rock crevice on Christmas Island (Indian Ocean).

it nests in small numbers on Mahé, in this group, and that there were over 1,000 pairs breeding on Aride at the time of his visit to the island (25 April to 8 May). Vesey-Fitzgerald also reports its presence in the Aldabra-Providence-Farquhar groups, south-west of the Seychelles. Gardiner (1903 (1): 369) says that he saw it on nearly every atoll in the Maldives, including Addu, and found it nesting at Hebaridu in South Mahlosmadulu atoll. He also found a single pair nesting on Diego Garcia, in the Chagos group; they were stated to have bred for a number of years in a large Pisonia tree (1907: 110). It cannot be common there; Bourne (in Saunders, 1886: 335) refers to frigate-birds and boobies on Diego Garcia, but he did not apparently see any tropic-birds. I cannot trace any record for the Laccadive Islands; Betts (1939: 386) does not list it.

The nesting site varies. Vesey-Fitzgerald (*loc. cit.*) says that on the larger islands of the Seychelles, such as Mahé, Silhouette and Praslin, this bird nests in hollow trees high up in the mountain forests, while on the smaller islands, such as Cousine, Frigate and Aride, it nests in holes in the ground and under overhanging rocks. The latter sites are confirmed by Betts who says that on Aride the egg is normally laid on the bare ground in a dark and sheltered spot in a rock crevice or under a boulder, often at a considerable depth and concealed by long grass. In the Maldive Archipelago Gardiner (*loc. cit.*) found three nests in a hollowed-out branch of a Tulip Tree, *Hernandea peltata,* and his collector two others in a neighbouring tree. Vesey-Fitzgerald does not give any breeding dates. Betts found mostly eggs and very young birds on Aride at the end of April. Gardiner's nests were located on 24 November; one contained an egg and three had single nestlings. I found two nests on the Cocos-Keeling Islands, one in May and the second in June, each contained a single egg. They were situated on the ground, among coconut palms, and partly in the shelter of scrubby bushes.

The Golden Longtailed Tropic-bird, *P. l. fulvus,* the other race occurring in the Indian Ocean, is known to nest only on Christmas Island where there were about 300-450 breeding pairs in 1938-40 (Gibson-Hill, 1947*b*: 95 & 143-6). It has been observed over open water as far north as Java Head, and it is said to stray occasionally to the edge of the Cocos-Keeling group, about 530 miles west of Christmas Island. It has not been reported outside these limits. Apparently it nests only in cavities in the trunks of dead or dying trees, usually at a height of 25-50 feet from the ground. A favourite place is a hollow that has rotted inwards where a main branch has fallen away. This site is very similar to the ones recorded for the typical race by Gardiner, and some of those noted in the Seychelles by Vesey-Fitzgerald. It is possible that a few individuals breed in each month of the year, but from notes made by the present writer on Christmas Island it seems that the majority of the eggs are laid between June and October.

The adult Longtailed Tropic-bird can be identified by its very long, white tail feathers and (in the Indian Ocean) yellow, greenish yellow or yellowish grey bill. Some birds have a lovely but fugitive golden apricot blush on the feathers of the breast, belly and back, but this is scarcely discernible when they are in flight. The Golden race from Christmas Island is most distinctive, and cannot be confused with any other bird. The areas normally white in an adult *Phaëthon,* including the elongated centre tail feathers, are here a rich apricot yellow, seeming, when the bird is seen sunlit in new plumage against a deep blue sky, as though they were burnished gold. Apart from this conspicuous distinction there appears to be little difference between the two races. The soft part colours are almost the same and, as the following measurements show, there is no significant variation in size.[1]

Coll. No.	Date taken	Sex	Total length	Tail	Wing flat	Tarsus	Exposed culmen	Bill to gape
P. lepturus lepturus (Cocos-Keeling Islands).								
V12	13 : 3 : 41	♂	651	355	277	25	51	76
V13	26 : 2 : 41	♂	678	405	274	23	48	67
V15	23 : 2 : 41	♂	772	474	155+	23	49	72
V16	30 : 1 : 41	♂	707	416	279	23	50	72
V17	2 : 10 : 41	♂	636	384	274	24	50	74
V18	2 : 10 : 41	♂	640	356	281	24	50	73.5
V19	17 : 10 : 41	♂	790	501	273	23	48	72
V14	26 : 2 : 41	♀	775	482	276	24	50	68
P. lepturus fulvus (Christmas Island).								
D38	6 : 12 : 40	♂	726	415	280	23	49	72
D39	6 : 12 : 40	♂	810	524	285	23	51	72
D36	12 : 11 : 40	♀	744	440	287	25	52	74·5
D37	21 : 11 : 40	♀	739	451	279	23	50	69

Phaëthon rubricauda Bodd.: *Redtailed Tropic-bird.*

Two races of this bird are known from our area. The typical race (type locality, Mauritius) which occurs in and near the Mascarene Islands, and the Western Australian race, *P. rubricauda westralis* Math. (type locality, Houtman's Abrolhos, West Australia), which is found in the eastern portion of the Indian Ocean and in the Banda Sea.

The typical race of the Redtailed Tropic-bird is not numerous and has a very restricted range. It breeds on Round Island, near Mauritius (but not on Mauritius itself), and on Assumption Island (Baker, 1929: 293), and on the Cosmoledo atoll and the southern island of the Aldabra group (Vesey-Fitzgerald, 1941: 530). There are no recent accounts of its status in the Mascarene group. From Vesey-Fitzgerald's account, and that of Betts (1940: 530), it certainly does not appear to be plentiful in the Aldabra area. It is known from open water in both these neighbourhoods, but there are no authentic records of it from much further afield and no specimens have been

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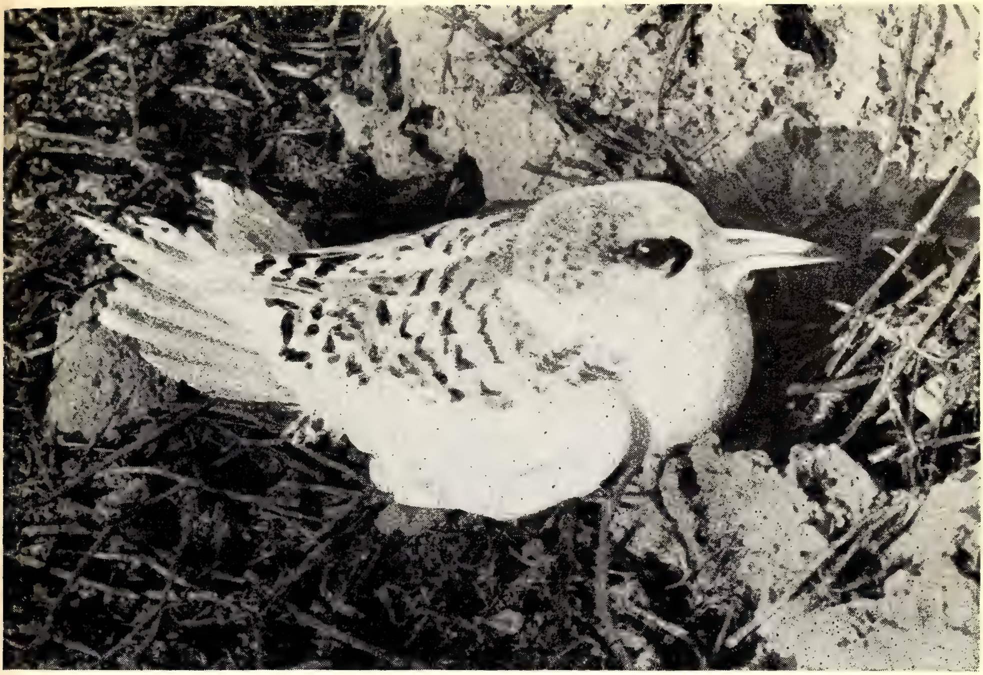
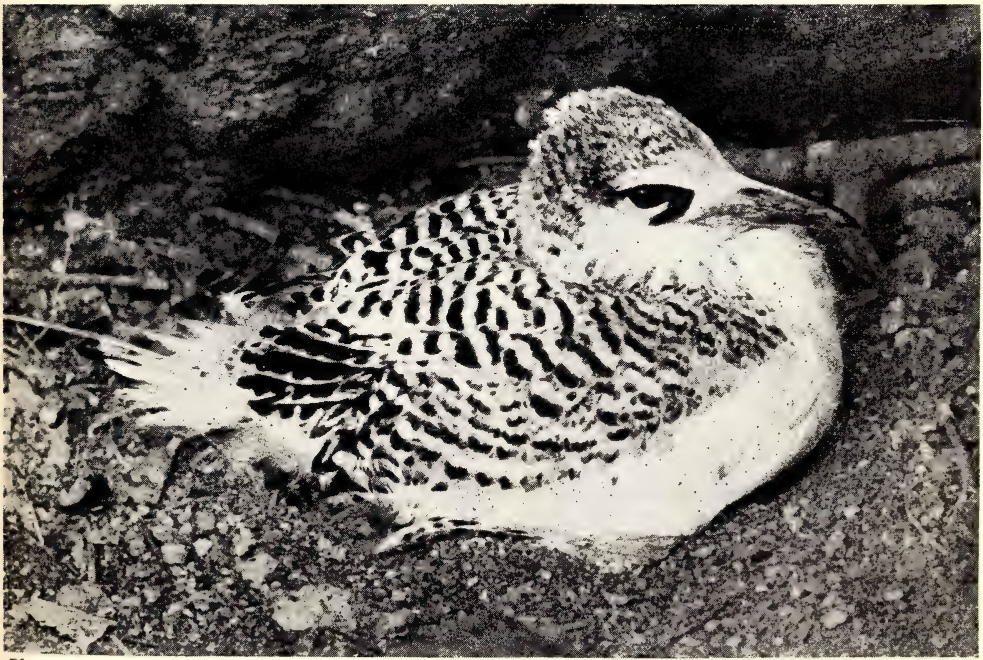
[1] Measurements, in mm., in the flesh of specimens taken by the present writer on Christmas and the Cocos-Keeling Islands (1940-41). The tail is measured from the base of the longest rectrice, the exposed culmen from the tip of the bill to the beginning of the feather tract.



A juvenile of the Christmas Island race of the Long-tailed Tropic-bird—*P. lepturus fulvus.*



Photos *C. A. Gibson-Hill*

A juvenile of the Red-tailed Tropic-bird—*P. rubricauda westralis,* photographed two or three days before leaving its nest.

taken north of the equator. Baker (*loc. cit.*) erroneously includes the Red Sea and the Persian Gulf in its range, as he does for the preceding species. Some of the earlier visual records of the Short-tailed Tropic-bird, *P.a. indicus,* were taken to be immature specimens of the present bird, and Irvine incorrectly ascribed the egg which he took on an island in the Persian Gulf in 1898 to it, but there is nothing to show that it has ever really been encountered in these areas.

The race *P.r. westralis* occurs in the eastern part of the Indian Ocean. It is known to breed on Houtman's Abrolhos off the west coast of Australia[1] (Mathews & Iredale, 1921: 81), on Christmas and the Cocos-Keeling Islands, and on Gunong Api, in the Banda Sea (van Bemmel & Hoogerwerf, 1940: 451-7). The present writer found a population of about 400-600 pairs on Christmas Island in 1938-40 (1947*b*: 95 & 137-43), and one pair on the Cocos-Keeling Islands in 1941 (1949*b*: 235). It is known from the open sea between the latter two islands, and from this area north to Java Head and the entrance to the Sunda Straits, but there do not appear to be any authentic records for the south coast of Java or the south-west coast of Sumatra.

The two areas given in the paragraphs above cover the known breeding grounds of *P. rubricauda* in the Indian Ocean. It is possible, however, that there is another hitherto unlocated nesting site somewhere in or near the southern part of the Bay of Bengal. Jerdon (1864: 850) describes it as 'frequently seen in the Bay of Bengal'. This is certainly an exaggeration, but specimens are known from the neighbourhood of the Nicobars. Hume (1874: 322) refers to an example of this species sent from these islands to Blyth, which the latter erroneously called *æthereus.* In the following paragraph he discusses 'a very fine male' from the Bay of Bengal, of which he gives the measurements and a brief description. The wording is ambiguous and these two entries may refer to the same specimen, but at least they give us one undoubted *rubricauda* from this area. More recently I have handled an example of this species, an immature male in the last juvenile plumage, which came on board a ship passing between the Nicobars and the northern point of Sumatra (1949*a*: 100-4). It is of interest to note that Hume gives the length of the culmen in the bird which he measured as 2.6″ (=66 mm.), and the recent example has an exposed culmen of 69.5 mm. Mathews made at least two attempts to frame a definition of his race *westralis,* but the only character which really stands is its shorter bill. Mathews (1912: 88) quotes 76-80 mm. for the length of the exposed culmen in typical *rubricauda.* 14 adults from Christmas Island and 2 from the Cocos-Keeling Islands which I have measured have a culmen range of 58-65 mm. van Bemmel & Hoogerwerf (1940: 452) give 55-61 mm. for 3 adults from Gunong Api. The difference is very small, but the two birds from the Nicobar area are certainly larger than any known examples of *westralis.* On the other hand Baker

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[1] The type locality of *westralis* is Rat Island in the Houtman's Abrolhos group, but it is by no means common in the area. Six nests were located in the season 1947-48 (Serventy & Whittell, 1948: 121). A single nest was recorded on the mainland near Busselton in November 1939.

(*loc. cit.*) gives the culmen length for this species as 66-69 mm., but without disclosing the locality of his specimens. 66-69 mm. is well below the published range of the typical *rubricauda*. It is just possible, therefore, that there is a so far unrecorded breeding ground somewhere off the coast of Sumatra or in the Nicobars from which these examples have come. If such a colony does exist it would be quite natural for its birds to be intermediate in character between the typical race to the west and *westralis* to the south-east. It was partly in the hope of finding it that an examination was made of Pulo Perak, an isolated barren islet in the middle of the northern portion of the Malacca Strait, in April 1949, but unfortunately no evidence was seen of tropic-birds breeding there.

No difficulty should be experienced in identifying the adult of *rubricauda*. It is much bulkier than the other two tropic-birds, with relatively shorter central tail feathers. Further these have very attenuated webs, with the shafts black and the webs a deep red. The bill ranges from orange-red to vermillion. Often the birds have a fugitive roseate blush on the feathers of the breast, belly and back, but this is a variable character and scarcely discernible in flight. As noted above the two races occurring in our area cannot be distinguished in the field. Immature birds have the black-marked plumage common to all young tropic-birds, but the dark areas are more extensive, and again they are bulkier and heavier in build. The distinguishing points in the wing and tail feathers are given under *P.a. indicus*.

SUMMARY

This paper gives a brief account of the tropic-birds occurring in the Indian Ocean and attempts to summarise what is at present known of their range here. All three recognised species nest in this area. *P. aethereus indicus* is known to be breeding at the eastern end of the Persian Gulf, and in the area round the lower end of the Red Sea and the Gulf of Aden; its normal range would seem to be the Arabian Sea and adjacent waters; there are doubtful records of strays in the Bay of Bengal. *P. l. lepturus* is breeding mostly in the Mascarene, Seychelle and Maldive groups in the western Indian Ocean, with a few pairs on Diego Garcia and the Cocos-Keeling Islands further east; it is known as a straggler to the Bay of Bengal. The race *P. l. fulvus* nests only on Christmas Island and is known from neighbouring waters. *P. rubricauda* is breeding on Round Island (near Mauritius), on Assumption and at the south-west end of the Seychelles (typical race), and on the Cocos-Keeling Islands, Christmas Island and islands off the north-western coast of Australia (the race *westralis*); it is also known from the neighbourhood of the Nicobar Islands, and there may be a third breeding centre in this region.

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A NOTE ON THE PLATES

Plate I:

1. An adult of the Longtailed Tropic-bird, *Phaëthon l. lepturus,* in flight, seen from below. The tail in this example is rather shorter than usual, and very little longer than in the Shorttailed species. Under these circumstances the colouration of the bill (in the Indian Ocean red in *indica* and yellow or greenish yellow in *lepturus*) is the only reliable character by which the bird can be identified in the field, unless a really good view is obtained of the back. My general experience, however, is that one does not often see the back of a tropic-bird in flight at all clearly, unless one is in a position overlooking a nesting site.

2. The Christmas Island race, *P.l. fulvus,* of the Longtailed Tropic-bird in flight, seen from below. Unfortunately the picture was taken almost dead into the sun, but it gives a good indication of the length of a well developed tail in this species.

Plate II:

3. An adult of the Redtailed Tropic-bird, *P. rubricauda westralis,* coming into its nesting site. The picture shows the relatively short, narrow, whip-like centre tail feathers. The right hand one is about fully grown and the left hand one projecting only a few inches beyond the other rectrices.

4. A Redtailed Tropic-bird sitting on its nest on Christmas Island. The picture shows the manner in which the birds make use of small crannies or crevices. In this case the end of the right wing and the elongated centre tail feather are twisted sideways by the rock wall immediately behind the sitting bird.

Plate III:

5. An immature Longtailed Tropic-bird, *P.l. fulvus,* just after leaving its nest. This bird was apparently on its way out to sea, but failed to clear the vegetation and came down on the ground in the jungle. It seemed to be unable to get in the air again on its own, but flew strongly when it was liberated over open ground. The picture should be compared with No. 6 as it shows the much lighter appearance and smaller markings in the young *lepturus.*

6. An immature Redtailed Tropic-bird, *P.r. westralis,* photographed on its nest on Christmas Island. The bird is fully developed and had flown when the site was visited again 3 days later. The picture shows the much heavier dark markings on the dorsal surface on the young bird of this species, particularly on the secondaries.

WILD LIFE RESERVES IN INDIA: ASSAM.

BY

E. P. GEE, M.A., C.M.Z.S., F.R.G.S.

(With two plates, a map and a table)

Assam consists of two separate administrative set-ups: firstly the province itself which includes all the plains areas, with only a small part of the hills, and secondly the Tribal Areas, which are mountainous, sparsely inhabited and in some cases unexplored. The province itself is, of course, under the provincial government with the usual Forest Department, in whose care are the forests and the wild life contained therein. The Tribal Areas, on the other hand, are under the Governor of the province—the Centre's representative—and his Adviser. A completely separate political department with its own Forest Officers looks after these areas with varying degrees of control. And under the new Constitution it seems that the general relationship of the Tribal Areas with the province will not be vastly different from what it was before.

THE COUNTRY AND ITS FORESTS

As the forests of the plains are mainly close to the foothills, most of Assam's wild life is now to be found near the borderland of these two administrations, provincial and political. It is for this reason that there is all the greater need for a separate Game Warden and/or Wild Life Department, which would be in a position to coordinate measures for the protection of wild life in both the provincial and tribal areas. This is particularly important as a large amount of fauna is migratory and spends the cold, dry season in the plains, but resorts to the hills in the rainy season when heat and floods compel the seeking of higher altitudes. Thus they pass from one sphere of control to another, often with disastrous results.

The area of Reserved Forests in the province itself is 6,675 sq. miles, or about 11 per cent of the total area. An effort is being made, it is understood, to increase this area of 11 per cent to something nearer the advocated 20 per cent by bringing in some of the 14,507 sq. miles of Unclassed State Forests. The gradual opening of these U. S. Forests for cultivation in the drive for greater food production has already caused a serious diminishing of this type of forest and the wild life it shelters. The area of actual sanctuaries, where wild life is completely protected, is only 426 sq. miles, or 6.4 per cent of Reserved Forests and .7 per cent of the total area of the province.

With regard to the Tribal Areas it is reported that the authorities concerned have taken steps to reserve some 1,700 sq. miles of forests. A region of 800 sq. miles near the borders of Assam, Burma and China has been declared as the Tirap Frontier Tract National Park, and an access road to it is now being opened up from the Ledo Road.

As head-hunting and inter-tribal wars have ceased, peace and 'civilization' with increasing population is causing an increase in the *jhuming* (shifting cultivation) for greater food production, with resultant loss to forests and wild life. It is obvious that sooner or later more forest reserves, especially in the catchment areas of the larger rivers, will need to be formed both for soil protection and flood prevention as well as for the preservation of the diminishing fauna and flora.

The type of terrain in this part of India varies according to altitude. Near the large rivers of the plains there are vast tracts of *bheels*, swamps and lowland savannah, such as constitute most of Kaziranga Game Sanctuary—ideal country for rhino, buffalo and deer except when abnormally high floods occur. Midway between these plains rivers and the hills are dense evergreen and mixed deciduous forests, which extend far into the foothills. Higher up in the Tribal Areas are thinner mixed forests with bamboo and plantain, and at 4,000 feet are to be found pine, oak, rhododendron and similar forests until the Tibetan type of country is eventually reached in the north. The fauna, only migratory within certain altitudes, naturally conforms to the terrain in which it is usually found.

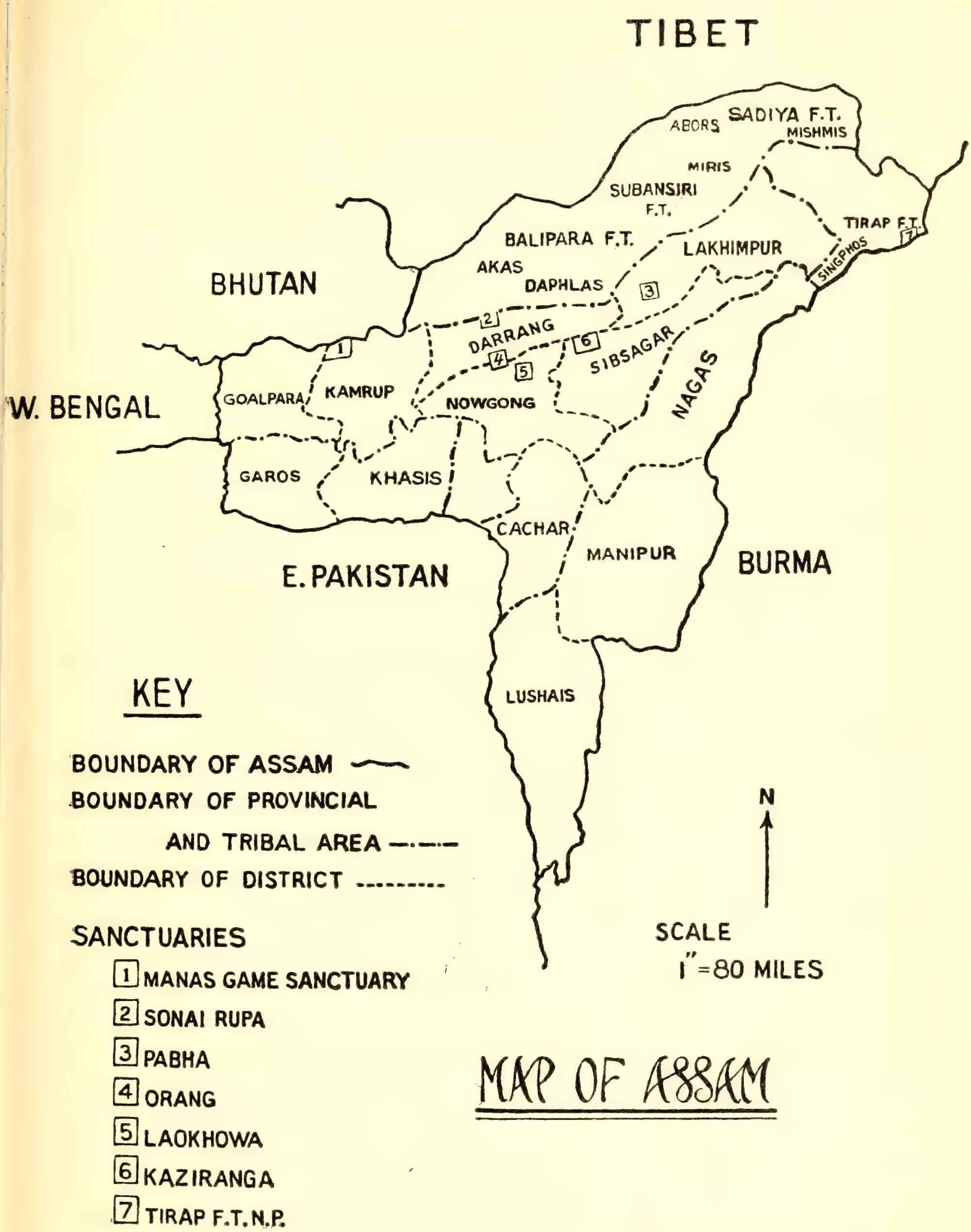
MEASURES TO PRESERVE WILD LIFE

Prior to 1930 little was done in Assam for the preservation of wild life, except the formation of the Manas and Kaziranga Game Sanctuaries for the protection of the Great Indian One-horned Rhino (*Rhinoceros unicornis*), which about 1905 had become very scarce due to the demand for its horn. For the protection of the elephant, of course, measures had been taken with the rest of India in accordance with the Elephant Preservation Act 1879.

In the early thirties, however, the revival of interest in wild life which was evident in most parts of India found Assam with one of its great Conservators of Forests—the late Mr. A. J. W. Milroy. It was due to him that the Elephant Hunting Rules became law, and catching operations were humanized and properly supervised, with immediate releases of cows with suckling calves caught in stockades. Extensive poaching in the Manas area was cleaned up by a company of Assam Rifles. Rhino horns were declared to be forest produce wherever found. Energetic steps were taken to encourage *bona fide* sport and study of natural history, and to prevent poaching and illicit shooting of any kind.

Later the new Shooting Rules for the Preservation of Wild Life in Reserved Forests came into force in 1938, with limits and royalties fixed for each type of game shot by license-holders, and so forth. Then came World War II in which Assam was the scene of preparations for operations in Burma, with vast numbers of military personnel stationed all over the province. The loss to wild life by indiscriminate shooting, dynamiting, etc., was as one would expect in war time, and was accompanied by a decline in effective interest by the authorities and public alike.

Early in 1949 the Assam Government invited the Bombay Natural History Society to send a party of naturalists to enquire into the wild life of the province, and to offer recommendations for improving and



MAP OF ASSAM

TIBET
ABORS
SADIYA F.T.
MISHMIS
MIRIS
SUBANSIRI F.T.
BALIPARA F.T.
LAKHIMPUR
AKAS
DAPHLAS
TIRAP F.T.
SINGPHOS
BHUTAN
DARRANG
SIBSAGAR
NAGAS
W. BENGAL
GOALPARA
KAMRUP
NOWGONG
GAROS
KHASIS
CACHAR
MANIPUR
BURMA
E. PAKISTAN
LUSHAIS
1
2
3
4
5
6
7
KEY
BOUNDARY OF ASSAM
BOUNDARY OF PROVINCIAL AND TRIBAL AREA
BOUNDARY OF DISTRICT
SANCTUARIES
1 MANAS GAME SANCTUARY
2 SONAI RUPA
3 PABHA
4 ORANG
5 LAOKHOWA
6 KAZIRANGA
7 TIRAP F.T.N.P.
N
SCALE
1" = 80 MILES

publicising the sanctuaries. Mr. Sálim Ali and Dr. Dillon Ripley with another came to Assam in March, and visited the four main sanctuaries. Mr. C. G. Baron gave them assistance and information concerning the Manas Game Sanctuary, while the writer had the privilege of accompanying them into Kaziranga Game Sanctuary and Pabha Reserve. The Conservator of Forests, Mr. P. D. Stracey, himself a keen naturalist, made all arrangements and maintained contact with the party. Mr. M. C. Jacob, the Junior Conservator of Forests also contacted the party in Kamrup.

In a memorandum submitted later to the Assam Government, this commission made valuable suggestions for the improvement of the sanctuaries and for the protection of wild life in general. In particular it exposed the optimistic complacency which had hitherto prevailed concerning the rhino population. The numbers of rhino are now considered to be much less than previously estimated by the Forest Department.

Wild Life Sanctuaries

The **Manas** or **North Kamrup Game Sanctuary** consists of 105 sq. miles at an elevation of 200 to 700 feet above sea level, and was formed in 1905. It is not quite so accessible as Kaziranga, being some 90 miles by road from Gauhati, the nearest airfield. It is 10 miles from Barpeta Road Railway Station, and a cold weather road runs up through the sanctuary to the Bhutan Hills, along the Beki river (the eastern branch of the Manas). It is a place of great scenic beauty, and has the additional asset of good fishing in the rivers at certain times of the year.

The number of rhino in this sanctuary is variably estimated as 150 (Mr. Baron), 100 (the Conservator), 40-50 (the Divisional Forest Officer), and 8-9 (Mr. Sálim Ali and Dr. Ripley, who saw only the tracks of two during their six-day visit to the western portion of the sanctuary). There is obviously scope here for further investigation, and it is to be hoped that the Forest Department will arrange for this. Pending more information on the matter, it would not be unreasonable to put the figure at 45. Elephant are estimated at 250 and buffalo at 500, while bison would be in the neighbourhood of 100. Besides these there are many other animals and birds. The proposed hydroelectric scheme of the Manas river must be taken into consideration in any plans for the development of this sanctuary.

The **Sonai Rupai Game Sanctuary** consists of 85 sq. miles, is at an elevation of 400 to 700 feet above sea level, and was formed in 1934. This sanctuary is not very accessible, and game in it is extremely difficult to find owing to the impenetrable nature of the terrain and the restricted visibility. It is, however, an excellent Natural Reserve, and will continue to be so if poaching can be eliminated. It is estimated to hold a few rhino (about 5), over 50 bison, some buffalo and other game. Like the Manas Sanctuary, this place is adjacent to the hills and there are good tracts of forests to the east and west, with resultant migrations to the hills and movements laterally.

The **Pabha Reserve** or **Milroy Buffalo Reserve** is an area of 20 sq. miles at an elevation of 300 to 350 feet, and was made a sanctuary in 1941. It is in a most inaccessible place and beyond the scope of tourists and visitors except of the serious naturalist type. It contains little beyond the buffalo, variably estimated from 50 to 150 head. These are a useful stock, as the bulls breed with the domesticated cows.

The **Orang Reserve** is a small sanctuary of about 24 sq. miles, at an elevation of only 200 to 250 feet, and was formed in 1915. It is on the north bank of the Brahmaputra, and is reported to contain about 10 rhino.

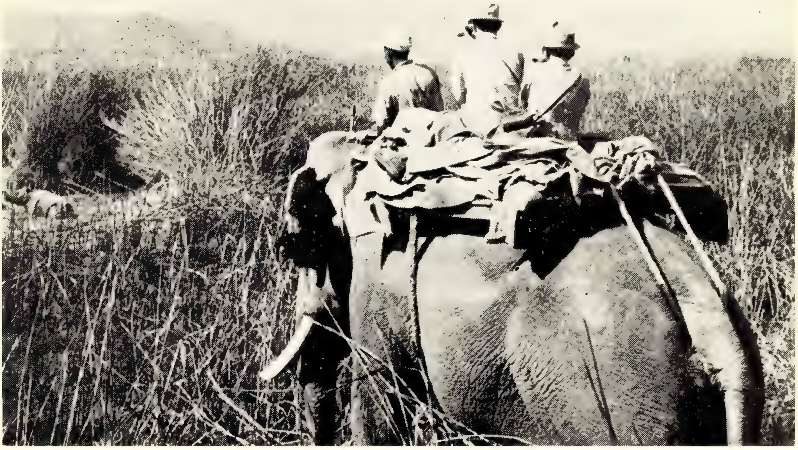
The **Laokhowa Reserve** is another small sanctuary for rhino of 26 sq. miles, at an elevation of 200 to 250 feet. It is on the south bank of the Brahmaputra, west of Kaziranga, and is supposed to contain about 20 rhino. Being overshadowed by its more important neighbour Kaziranga, this place is seldom visited and receives little attention.

The **Kaziranga Game Sanctuary** is the chief sanctuary of Assam for rhino and other game. It is 166 sq. miles in extent, is at an elevation of 200 to 250 feet above sea level, and was formed in 1908 when as a Reserve it was closed for shooting in order to protect the few remaining rhino from extinction. It became known as the Kaziranga Game Sanctuary in 1928, and was opened to visitors in 1937 when it was known that rhino had considerably increased in numbers. It stretches from milestone 116 to 140 on the main Assam Trunk Road, mid-way between Gauhati and Dibrugarh, and is very accessible to visitors. Only 50 miles from the regularly used airfield of Jorhat, its fame as a show place should increase.

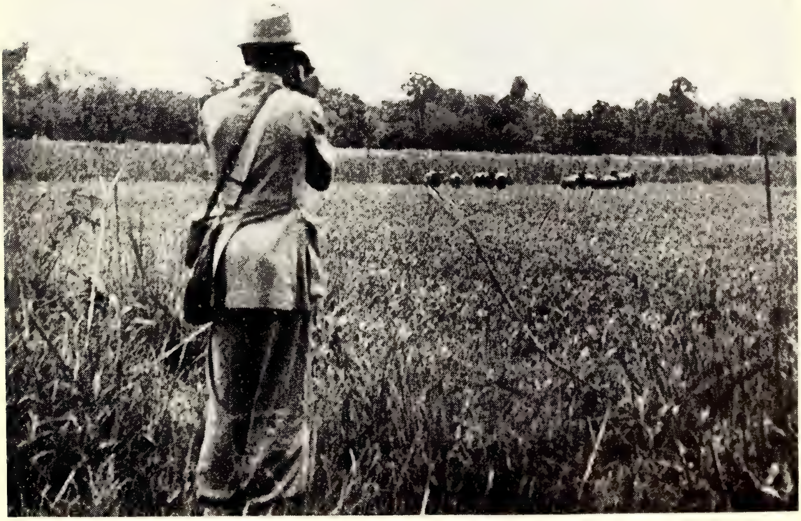
The number of rhino in Kaziranga was believed to have been about 300 in 1940, when one could go in on inspection elephants and see a dozen quite easily. Nowadays, however, a similar visit would produce only half that number, and a number of rhino are known to have died of anthrax in 1947—no less than fourteen carcasses having been found. The present population is reckoned as being 150 head, and needs careful protection from trespass by domestic cattle.

In addition, there are about 500 head of buffalo in this sanctuary and numbers of hog deer, barking deer and pig. Swamp deer are becoming rarer, probably due to poaching. The bison have disappeared, but a small herd of elephant still remains. Kaziranga is also a valuable sanctuary for fish and wild-fowl which abound in and on its numerous *bheels*, and the poaching of these *bheels* needs elimination. It is to be hoped that the authorities concerned will pay heed to the resolution passed by the recent UNSCCUR conference of UNESCO, which urged that all steps be taken to make Kaziranga a good and inviolate sanctuary, free from cattle trespass and other harmful influences.

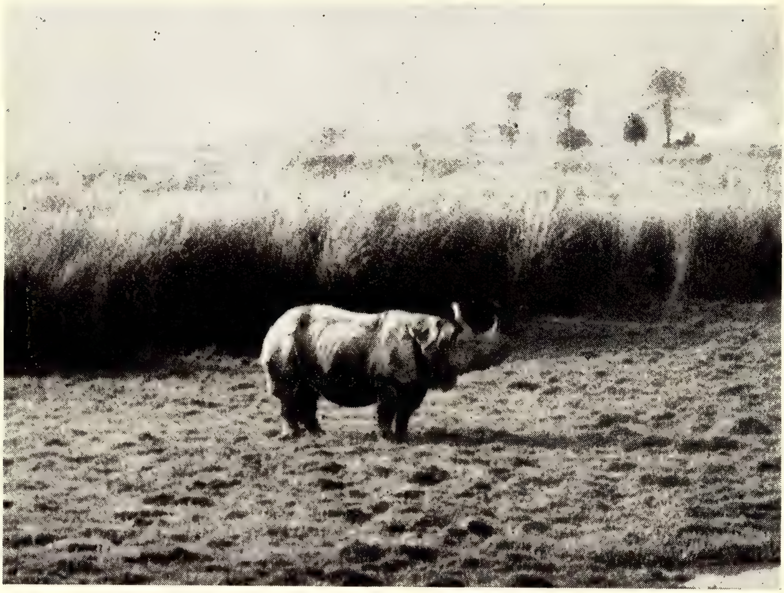
The **Tirap Frontier Tract National Park** has only just recently been gazetted. It is a mountainous region in the corner of Assam where the borders of Burma and China meet, rather inaccessible and



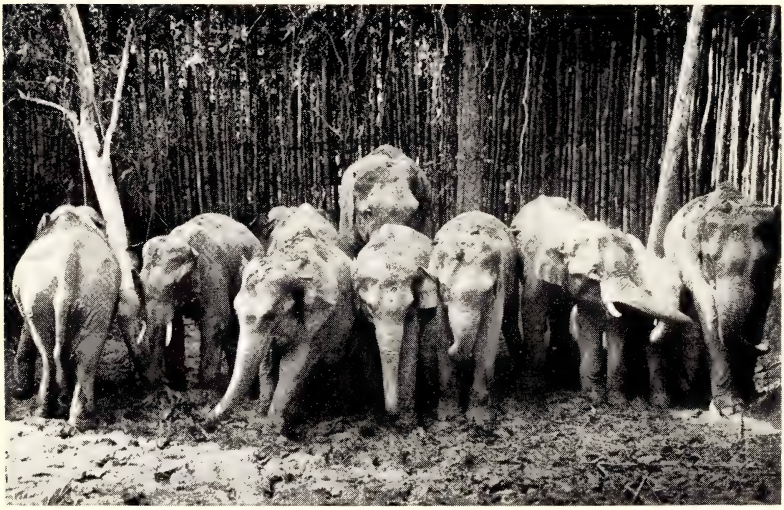
A half-grown rhino is cine-filmed by Dr. Dillon Ripley and Mr. Salim Ali in Kaziranga Game Sanctuary.



This herd of wild buffalo in the Pabha Reserve stood for their cine picture, and then disappeared into cover.



This full-grown bull rhino in Kaziranga Game Sanctuary charged us once, and was thinking about repeating his charge as this picture was taken.



Photos by *Author*

A catch of fourteen wild elephants in a stockade in Assam.

impenetrable. The official description of the park as a wild life sanctuary is: 'The area chosen is a meeting place of Burmese and Indian flora and fauna and will be the only place in the world where certain species such as takin, musk deer and serow are protected, and it is believed that a few specimens of *Rhinoceros sumatrensis,* which is extinct elsewhere, survive in the proposed park.'

The writer has lately been making careful enquiries, however, and it appears to be very doubtful if these rhino still exist. Musk deer, takin and serow are probably to be found in greater numbers on the north bank of the Brahmaputra in the foothills of the Himalayan Range, in less inaccessible places. In fact it seems doubtful if a wise choice has been made by the authorities concerned for a National Park in this forbidding area, which is more in the way of being a Natural Reserve suitable only for the more serious type of scientific naturalist. It is five days' march from the nearest road, and lacks any kind of track except a few made by wild elephants. It would be a pity if money was expended on a project of such doubtful value, when other urgent proposals for the protection of wild life are having to be shelved. There may yet be time to reconsider the necessity of creating this park, and the present Adviser to the Governor has assured the writer that the fullest consideration will be given to the views expressed above. In the meantime the axe of economy has descended abruptly on this as well as on other similar projects.

THE MORE IMPORTANT FAUNA

Elephas maximus. The Indian Elephant is Assam's most important animal from the economic point of view. The revenue from elephant royalty and monopoly fees collected after catching operations has been considerable in recent years:

1945-46	282 elephants	Rs. 2,41,702
1946-47	350 elephants	Rs. 4,23,642
1947-48	370 elephants	Rs. 4,43,332

In spite of these numbers having been caught and others having been shot by holders of Control Licenses, the elephant population seems to be in a strong position. If an average of 334 elephants are captured or killed each year, it would mean that if their numbers remained the same their total population would be in the neighbourhood of 5,350 head for both the province and the Tribal Areas. The valuable stock of wild elephants should not be allowed to suffer too severe a reduction. The policy of the Forest Department has wisely been to allow catching operations only in those areas in which elephants are known to be on the increase, or causing serious damage to crops. In addition to this, holders of Control Licenses destroy the occasional rogue or solitary male doing damage.

The recent epidemic which caused the death of at least 55 wild elephants in the North Cachar Hills is a cause of great concern. The outbreak, which occurred last June and July, has not yet been fully investigated. A similar epidemic some ten years ago in exactly the same area caused many deaths of elephant and bison, and it is to be hoped that the Forest Department will be successful in their efforts to prevent a recurrence.

Rhinoceros unicornis. The Great Indian One-horned Rhinoceros has the honour of being Assam's most important animal from the point of view of scientists and naturalists. It is becoming rarer each year, in spite of supposed protection. The rhino population (as far as this species goes) is probably now as follows: Nepal 50 (6 were recently shot by two Indian diplomats), Bihar 5, Bengal Duars 30, Cooch Behar 20, Assam 240. Total 345. Assam's total of 240 are believed to exist in these localities: Manas 45, Sonai Rupai 5, Orang 10, Laokhowa 20, Kaziranga 150, and elsewhere 10.

It will be realized, then, that it is on Assam that rests the main responsibility of preserving this valuable species from extinction for posterity. This is especially important as it is thought that the two other species—the Smaller One-horned or Javan Rhino (*R. sondaicus*) and the Sumatran Two-horned Rhino (*R. sumatrensis*)—have by now become extinct in India, though a few may remain in the Chittagong Hill Tracts of East Pakistan.

Bibos gaurus. The Gaur or Bison is becoming increasingly rare in Assam, and will soon be non-existent except in the sanctuaries. It is believed that a herd still exists in company with buffalo in the North Cachar Hills at Langrao Haju. The possibility of giving this fine creature full protection wherever it may be found could be well considered by the Forest Department. The wild bulls often interbreed with the domesticated Mithun (*B. frontalis*) or Gayal, in the hills.

Panolia eldi. The Brow-antlered Deer or Thamin has become practically extinct, except possibly near the swamps bordering the Logtak lake in Manipur where they were reported in small numbers recently. This is an animal needing complete protection. The other species of deer appear to be holding their own in the localities which favour them, except Swamp Deer which are in need of more protection.

Sus salvanius. The Pigmy Hog is found along the Himalayan foothills in Goalpara and Kamrup districts, but is now becoming very scarce.

The Carnivora are to be found in usual numbers, with an occasional white tiger and a fair number of black leopards.

The Pink-headed Duck (*Rhodonessa caryophyllacea*) used to be Assam's most interesting bird. Mr. Milroy reported it as being very scarce in the early thirties, and it is not known if it has been found since that time.

The Takin (*Budorcas taxicolor*), the Serow (*Capricornis sumatrensis*) and the Goral (*Nemorhaedus*) are found in the Tribal Areas at varying altitudes, usually, many days' march from the nearest road. Even more difficult to find is the Musk Deer (*Moschus moschiferus*).

OUTLOOK FOR THE FUTURE

The writer recently contacted the provincial Hon. Minister of Forests and the Conservator, and was assured that the suggestions contained in the memorandum submitted by the Bombay Natural History Society's commission had been studied, and that proposals were being drawn up for their implementation as far as possible. It is intended, apparently, to proceed with the sanctuaries one by one, with Kaziranga first where a tourists' hut is to be constructed, and a pen made for the ecological study of a pair of rhino. It is hoped that a Game Warden will be appointed to work with and under the Conservator, and that the game staff of the province will be increased.

At the same time, however, it has become apparent that owing to lack of funds all proposals for new work have been shelved for the time being. This is disappointing news. It is surely false economy to postpone all measures for the improvement of this sanctuary, which is one of the most important in the world and has such great potentialities as an attraction for visitors and tourists, who should be encouraged so as to make the sanctuary self-supporting. Moreover the recent news of intensive poaching in Kaziranga makes us regard the future with concern. For a very small sum of money it is obvious that considerable improvements of an urgent though temporary nature can be effected as a gesture. The permanent and costlier work could wait until more funds and staff are available.

It costs very little money to plan new sanctuaries, and these are urgently needed before it becomes too late. In the province there are several forests of great scenic beauty and still abundantly stocked with wild life, which should immediately be formed into sanctuaries, or even National Parks. In the northern portion of Goalpara district, at the foot of the Bhutan Hills, are some delightful Sal forests with streams for fishing and plenty of game including Peafowl (rarely found elsewhere in the province), Florican, Spotted Deer or Chital (*Axis axis*), and even a few rhino. While admitting that the mere gazetting of new sanctuaries without a proper supervisory staff lays them open to the danger of increased poaching, this procedure should not be detrimental if accompanied by publicity and visitors in sufficient numbers. An interested public intent on sight-seeing, photography and fishing (with rod and line) should prove to be the unpaid champions and protectors of the wild life of their district.

In the Tribal Areas there are some places in the Balipara Frontier Tract, such as Rupa, and in the Sadiya Frontier Tract, eastern portion, where the creation of sanctuaries or National Parks could be considered. Above all, the Logtak lake of Manipur State, now merged with the Centre and possibly later to be merged with Assam, is famed throughout the world as a paradise for wild-fowl and other birds. The few Thamin reported to be surviving in that locality require protection, and a National Park of this area could be formed with controlled shooting of wild-fowl for *bona fide* license-holder sportsmen only. In fact the whole stretch from Dimapur, where there is some big game still surviving, via Nichuguard, Kohima, Mao, Karong and Imphal to the Logtak lake could at once be a self-supporting National Park of immense possibilities for the preservation of wild life and as an attraction for tourists.

There are signs of an increasing volume of public opinion in Assam in favour of the preservation of fauna, and many sportsmen are now more interested in shooting with the camera. Of late many speeches and broadcasts on Assam's wonderful flora and fauna have emanated from important officials in Shillong. These cannot but augur for the good of wild life. But they are not enough; they must be followed up by at least some action and active encouragement to all the junior categories of forest staff.

Much depends on the Conservator himself, and as Mr. Milroy wrote: 'No help from the centre, however, can make up for lack of interest on the part of the officers on the spot, though an enthusiastic Conservator can do much to overcome apathy . . .' It is to be hoped that the Forest Department, on whose interest and endeavours so much depends, will find the active support of the public and achieve the ultimate success they deserve in the task of preserving Assam's fauna for posterity.

PARTICULARS OF WILD LIFE SANCTUARIES IN ASSAM

	Name of Sanctuary 1	Estd. year 2	Sub-division 3	District 4	Area 5	Cover conditions 6	Animals 7		Route for visitors 8
1.	Manas or North Kamrup Game Sanctuary	1905	Barpeta	Kamrup	105 sq. miles Elevation 200-700	North—thick forest South—grass and reeds. Rivers, streams and bheels. Road up R. Beki	Rhino Bison Buffalo	45 100 500	Barpeta Road Rly. Stn. (10 miles) Gauhati Airfield (90 miles)
2.	Sonai Rupai Game Sanctuary	1934	—	Darrang	85 sq. miles Elevation 400-700	Forest and grass etc. Streams and bheels No roads	Rhino Bison Buffalo	5 50 20	Missamari Rly. Stn. (2 miles) Tejpur Airfield (25 miles)
3.	Pabha Reserve	1941	North Lakhimpur	Lakhimpur	20 sq. miles Elevation 300 350	Forest and grass Streams and bheels No roads	Rhino Bison Buffalo	— — 100	Jorhat Airfield (40 miles)
4.	Orang Reserve	1915	Mangaldai	Darrang	24 sq. miles Elevation 200-250	Grass River and bheels No roads	Rhino Bison Buffalo	10 — —	Mazbat Rly. Stn. (15 miles)
5.	Laokhowa Reserve	—	—	Nowgong	26 sq. miles Elevation 200·250	Grass Streams and bheels No roads	Rhino Bison Buffalo	20 — 50	Nowgong (15 miles)
6.	Kaziranga Game Sanctuary	1908	Golaghat	Sibsagar	166 sq. miles Elevation 200-250	Some forest Mostly grass Streams and bheels No roads	Rhino Bison Buffalo	150 — 500	Jorhat Airfield (50 miles) Gauhati Airfield (130 miles)

Total number of sanctuaries	6
Total area of sanctuaries	426 sq. miles
Percentage of sanctuary area in relation to forest area	6.4
Percentage of sanctuary area in relation to total area of province	.7
Longest period for which sanctuary has been in existence	44 years

THE FOULING ORGANISMS OF PEARL OYSTER CAGES

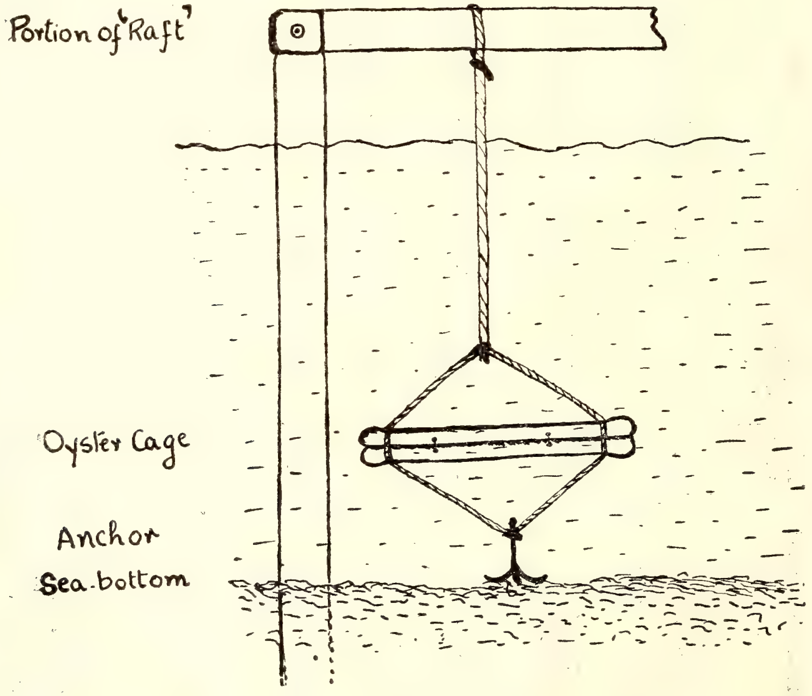
BY

George K. Kuriyan, m.sc., f.z.s.

(Published with the permission of the Director of Industries and Commerce, Madras.)

(With a text figure)

Pearl Oysters are cultivated at the Krusadai Biological Station by the so called 'raft or hanging method' which has been so popular along the coasts of Japan. They are placed in separate wooden cubicles, covered with wire-net frames, tied to a 'raft' and anchored to the bottom of the sea. While these are being cultivated, many animals, sessile and free living, are found to attach themselves to the cages. Besides being a nuisance in the oyster park in many ways, these 'fouling organisms' also compete as food rivals of the oysters, so that, in order to ensure a better and more rapid growth of oysters, it is necessary to clean the cages at frequent intervals.



The present note gives the occurrence of such organisms during the complete year from September 1947 to August 1948. The seasons of settling are also indicated.

Coelenterata: The most common Coelenterates attaching to the cages were *Pennaria disticha* Goldfuss, species of *Companularia, Obelia, Lytocarpus* and *Paranemonia*....Hydroids were found to settle throughout the year.

Nemertinea: A single specimen of *Eupolia* was observed amongst the fouling organisms in July.

Polyzoa: Polyzoan colonies were found to attach to the frames and at times to shell valves during the months from June to November. The more important of the colonies settling down were *Thalamporella rozierii* Andouin, and species of *Lagenipora* and *Membranipora.* The last mentioned genus was noticed in abundance during August and September.

Mollusca: Rock oysters, *Ostrea cucullata* Born, were common throughout the year.

Annelida: The tube-builder *Dasicone cingulata* Gurbe was abundant throughout the year. Some of them were noticed to attach themselves to the shell valves of the oysters. Of the other genera the following were found in the oyster cages in the months indicated against them.

Polydora hornelli Willey . . .	June and July
Lepidonotus carinatulus Gurbe . . .	August and September
Syllis gracilis Gurbe . . .	August
Syllis variegata Gurbe . . .	September
Phyllydoce spp. . . .	July and August

A few individuals of the heteronereid stage of *Perineris* were collected during August and some *Potodrilus* sp. were found to inhabit the cages in July.

Crustacea: The most common were the two species of Cirripedes belonging to the genus *Balanus* De Costa; *B. amphitrite* Darwin var. *venustus;* and *B. tintinnabulum* Linn. var. *communis.* Both varieties attach themselves to the shells of cultivated oysters. Lepas (*Lepas tunuivalvata* Annandale) was found in clusters attached to the wooden frames of the cages from July to September and in smaller numbers in May.

Of the sub-order Natantia, the following species were found: *Hippolysmata vittata* Stimpson (June to September); *Stenopus robustus* Borradaile (September and October); *Periclimenus spineferus* de Mann (June); *Alpheids* (September) and *Saron marmoratus* Oliver (July).

Reptantia: Crabs belonging to the family *Portunidae* were most abundant in the cages throughout the year. *Charybdys annulata* Fabricius, *Thalamitta prymna* Herbest, *T. admetta* Herbest, *T. woodmasoni* Alcock and *Neptunus pelagicus* Linn formed the majority.

The remainder belonging to the following families were also frequently noticed in the oyster cages.

1. Fam. XANTHIDAE: *Ozius rugulosus* Stimpson; *Xantho euglyptus* Alcock; and *Menippe rumphii* Fabr.

2. Fam. MAIIDAE: *Tylocarcinus styx* Herbest; and *Shizophrys aspera* Milne-Edwards.

Juvenile specimens of *Panulirus dasypus* Labicille were also found in July to September.

Echinodermata: Small specimens of *Pentaceras herdmani* Lutken were noticed in September and October; those of *Salmacis virgulata* Agassiz in August; and of *Astropecten indicus* Doderleir in June, July and August.

Tunicata: Compound ascidian *Diandrocarpa brackenhelmi* Michaelson was observed encrusting the oysters and the oyster cages during the months of south-west monsoon; the small dull reddish leathery ascidian of the genus *Polycarpa* Heller was common in November.

Pisces: Small specimens of the genera *Epinephelus*, *Tetrodon* and *Balistes* have been found to frequent the oyster cages at Krusadai Island. Specimens of *Petroskirtis leinardi* were also recovered frequently.

Sea weeds: Sea weeds were noticed to be washed on to the cages by the currents in the gulf. They settled more during the north-east monsoon period than in other seasons. The important genera of marine algae noticed adhering to the cages were *Chaetomorpha*, *Enteromorpha*, *Ulva*, *Codium*, *Padina*, *Sargassum* and *Gracillaria*.

During the months of south-west and north-east monsoons, the settling was greater. The gulf currents are mainly responsible for the distribution of these animals; but when currents were too strong the settling on the cages was considerably less.

I am grateful to Mr. M. Devidas Menon, B.SC. (Hons.), who initiated this work in Krusadai and to Dr. Beni Charan Mahendra and Mr. K. Chidambaram, M.A., F.Z.S., for their valuable suggestions and constructive criticisms.

CHAMPARAN BUTTERFLIES—NORTH BIHAR

BY

A. C. HARMAN

Before I left India some three years ago I had been making for many years a survey of the butterflies of the district of Champaran — but I do not think that I could have exhausted all the species to be found there. To the north of Champaran is the forest belt (Bettiah Raj and Ramnagar Raj) which is about 90 miles in length and about 10 miles deep. This borders on to the Nepal Terai and is separated from it by the Gandak River. The Himalayan foothills start here and rise to about 500 ft. at Treveni. Treveni Hill in Nepal must be about 3,000 ft. Thirty miles east of Treveni is Samashwa, where there is a dak bungalow at 2,800 ft. Beyond the ridge one can get a most gorgeous view of the Nepal hill ranges and snows.

I had not the facilities for exploring the jungles at all seasons of the year as it was almost impossible to get there in the rains—so certain butterflies must have been missed. My collecting was done mostly in the months September to May. For the purpose of this list I should divide the butterflies into two groups—those taken in the forest belt and those found in the cultivated area of the district. Stray forest species appeared from time to time in my garden near Bettiah—some 50 miles from the nearest jungle.

Note.—These butterflies are named and listed according to Evans's Indentification of Indian Butterflies—2nd edition revised. The specimens are deposited in the Forest Research Institute, Dehra Dun.

PAPILIONIDAE

A1. **Troides helena cerberus** Fd. Found along the Nepal border at Ramgarwa and other places.

A2. **Tros aristolochiae aristolochiae** F. Common most of the hot weather and rains.

A3. **Chilasa clytia clytia** L. This form is less common.

v. **dissimilis** L. Common form—appears March till December.

v. **dissimillima** Evans. Have taken one.

A4. 1. **Papilio memnon agenor** L. Strays seen and taken at various times.

♀ v. **butlerianus** Roth. One seen on 18-6-'33.

♀ v. **alcanor** Cr. One seen on 14-6-'33.

2. **Papilio helenus helenus** L. One seen and one taken.

3. **Papilio polytes romulus** Cr. Common from March to December.

♀ **v. cyrus** F. One taken by Mr. Gill at Japaha.

4. **Papilio demoleus demoleus** L. Common most of the year.

A5. **Pathysa nomius nomius** Esp. Appears about March and April only.

A6. **Zetides sarpedon sarpedon** L. Mr. Gill took one.

Zetides agammemnon agammemnon L. One worn specimen November '45.

PIERIDAE

B1. **Leptosia nina nina** F. Appears March–April and October–November.

B4. 10. **Pieris canidia indica** Evans. Flies in jungle belt only, November to March.

11. **Pieris brassicae** L. Appears end of January–February, sometimes larvae are in pest form; it is double brooded. Last brood hatches out middle April and disappears at once. I should say it migrates back to the Nepal hills as I have seen them on the road from Nepal, miles from any food plant!

B6. 3. **Delias eucharis** Drury. Common most of the year; Larvae feed on 'ohangi', also on pummaloe.

11. **Delias descombesi leucacantha** Fruh. Jungle belt. Flies August till December.

12. **Delias aglaia** L. Strays appear sometimes but mostly flies in jungle belt: October to April.

13. **Delias thysbe pyramus** Wall. Taken in jungle belt, November–December '28.

B8. **Belenois mesentina mesentina** Cr. Appears October–November. Common March till June. Larvae feed on *Capparis* have bred the dark *taprobana* form in June–July.

B9. **Huphina nerissa evagete** Cr. Common most of the year. Larvae feed on *Capparis*.

B10. 2. **Appias lalage lalage** Db. Stray specimens appear only for a day or two in early December evidently migrating from Nepal. Mr. Gill and I each took one on the same day in 1937 at a distance of 70 miles apart. Have only seen males.

4. **Appias libythea libythea** F. Mr. Gill took one at Motihari—June '38.

5. **Appias lyncida hippoides** M. Stray specimens found in the rains.

6. **Appias albina darada** Fd. Stray specimens found in the rains.

B11. 1. **Catopsilia crocale** Cr. Common March till December.

2. **Catopsilia pomona** F. Flies in company of above.

v. **catilla**. Not too rare.

4. **Catopsilia pyranthe minna** Herbst. Common June to December.

5. **Catopsilia florella gnoma** F. Not common as above.

B15. 4. **Terias blanda silhetana** Wall. Rare, but took a number of pupae—November 1934.

5. **Terias hecabe hecabe** L. Common.

B16. 14. **Colias croceus edusina** But. Appears March and April only.

B19. **Hebomoia glaucippe glaucippe** L. One stray specimen taken at Motihari by Mr Gill—June 1938.

B20. 3. **Pareronia valeria hippia** F. Common in rains. Breeds August to October. Larvae feed on *Capparis*.

♀ v. **philomela**. Not rare.

DANAIDAE

C 2. 1. **Danais aglea melanoides** M. Jungle belt. Appears November to April.

9. **Danais limniace mutina** Fruh. Common most of the year.

10. **Danais melissa septentrionis** But. Jungle belt. October to December.

12. **Danais plexippus** L. Common.

15. **Danais chrysippus** L. Very common.

v. **alcippoides** M. } Have seen examples of both these,
v. **dorippus** Cr. } but not taken.

C 3. **Euploea mulciber mulciber** Cr. Jungle belt. Strays down to Bettiah during rains: June to October.

7. **Euploea core core** Cr. Very common.

Euploea core vermiculata But. Common.

17. **Euploea klugii klugii** M. One taken September '34.

18. **Euploea crassa kollari** Fd. Rare. Appears in the rains.

Euploea crassa crassa But. One taken by Mr Gill at Japaha.

SATYRIDAE

D 2. 9. **Mycalesis perseus typheus** Fruh. Appears November to March. Common in the jungle.

10. **Mycalesis mineus mineus** L. Jungle belt. Flies October to March.

12. **Mycalesis visala visala** M. Jungle belt. Gill took them at Japaha.

28. **Mycalesis malsara** M. Jungle belt. Flies in March and April.

D 3. **Lethe [europa ?]** Examples of this I took many years ago at Ramgarwa, but have never seen it anywhere else. Mr. Inglis had it in his Durbhanga collection.

Lethe confusa confusa One taken at Samashawa (above 3,000 ft.) Nepal border, March 1928.

D14. 2. **Ypthima inica** Hew. Common March to December.

11. **Ypthima hubneri hubneri** Kirby. Common March to December.

13. **Ypthima avanta avanta** M. Jungle belt. Flies November-December-March.

15. **Ypthima baldus baldus** F. Jungle belt. Flies November-December-March.

D16. **Orsotrioena medus medus F.** Appears in the rains.

D22. **Melanitis leda ismene** Cr. Common most of the year.

D25. **Elymnias hypermoestra undularis** Drury. Jungle belt. Flies October to March.

NYMPHALIDAE

F 1. 7. **Charaxes fabius fabius** F. Rare. One taken September 1928; one seen 21-4-40.

F 2. 2. **Eriboea athamus athamus** Dr. Two pupae found on a babul tree December 1928. Not seen flying.

F18. 3. **Euthalia lepidea lepidea** But. Jungle belt. Appears November to March.

14. **Euthalia garuda suddhodana** Fruh. Common most of the year.

17. **Euthalia lubentina indica** Fruh. Rare. appears February-March, September to December.

28. **Euthalia nais** Forst. Jungle belt. One taken October 1932.

F24. 7. **Limenitis procris procris** Cr. Jungle belt. September to March; strays taken in Bettiah.

F.25. 2. **Pantoporia nefte inara** Db. Jungle belt. Two taken March 1928. One ♀ November 1928 and April 1938.

4. **Pantoporia selenophora selenophora** Koll. Jungle belt. One ♀ taken at Samashawa 2,800 ft. March 1926.

14. **Pantoporia perius** L. Jungle belt. Common September to March.

F26. 1. **Neptis columella ophiana**. Jungle belt. One ♀ taken 2 April 1934 and ♀ April 1937.

6. **Neptis hylas adara** M. Jungle belt. Appears October to April. Some strays taken near Bettiah.

8. **Neptis nandina susruta** M. Jungle belt. October to April.

32. **Neptis hordonia hordonia** Stoll. Jungle belt. October to April.

F27. 4. **Cyrestis thyodamas thyodamas** Bdv. Jungle belt. October to April.

F30. 1. **Hypolimnas misippus** L. Common in the rains.

♀ v. **alcippoides** But. One taken November 1935.

♀ v. **inaria** Cr. Three or four taken.

2. **Hypolimnas bolina** L. Common. June to November.

F34. 2. **Kallima inachus inachus** Bdv. Jungle belt. Rare.

F35. 1. **Precis hierta hierta** F. Least common of the genus. Some years absent.

2. **Precis orithya swinhoei** But. Common most of the year.

3. **Precis lemonias lemonias** L. do. do.

4. **Precis almana almana** L. do. do.

5. **Precis atlites** L. Not so common as above.

6. **Precis iphita iphita** Cr. Jungle belt only. November to April.

F36. 1. **Vanessa cardui** L. Generally appears from February to April. One seen early : 17 October, 1937.

4. **Vanessa canace canace** L. Jungle belt. Flies October to April. Rare.

F39. 1. **Argynnis hyperbius hyperbius** L. Appears October–November, March–April. Breeds.

F41. **Cupha erymanthis lotis** Sulz. Jungle belt. October to March.

F42. **Atella phalanta** Drury. Flies most of the year.

F43. **Issoria sinha pallida** Evans. Jungle belt. November to April.

F45. **Cirrochroa tyche mithila** M. Mr Gill took them, July 1937.

F47. 3. **Cethosia cyane** Drury. Jungle belt. November to April.

F49. **Ergolis merione tapestrina** M. Common in the rains.

F52. **Telchinia violoe** Fab. Rare. One taken at Bhikna Thori (Nepal border) 17 March, 1937. Mr Gill took some at Japaha.

ERYCINIDAE

G1. **Libythea myrra sanguinalis** Fruh. Jungle belt. One taken at Treveni, March 1930.

G4. **Abisara echerius angulata** M. Jungle belt. Appears November–December.

LYCAENIDAE

H11. 1. **Castalius rosimon rosimon** F. Appears most of the year.

2. **Castalius caleta decidia** Hew. Jungle belt. Taken during October to March.

H12. **Tarucus theophrastus indica.** Flies June till September.

H13. **Syntarucus plinius** F. Flies June till November.

H21. **Lycaenopsis puspa gisca** Fruh. Jungle belt. Appears October to March.

Lycaenopsis cardia dilecta M. One stray specimen taken July 1936.

H23. **Chilades laius laius** Cr. Common most of the year.

H24. 1. **Zizeeria trochilus putli** Koll. Common June to September.

3. **Zizeeria gaika** Trimen. Common most of the year. One rare aberration taken 1 April, '37 and sent to Mr D. G. Sevastopulo.

6. **Zizeeria otis otis** F. Common most of the year.

H25. 1. **Euchrysops cnejus** F. Appears September to November.

H26. **Lycaenesthes emolus emolus** God. Rare. Appears October–November.

H27. **Catachrysops strabo** F. Common most of the year.

H28. **Lampides boeticus** L. Appears February to April and October–November.

H29. 1. **Jamides bochus bochus** Cr. Jungle belt. October to December–March.

5. **Jamides celeno celeno** Cr. Jungle belt. October to December–March.

9. **Jamides alecto eurysaces** Fruh. Jungle belt. October to December–March.

H32. 15. **Nacaduba nora nora** Fd. Common June to November.

16. **Nacaduba dubiosa indica** Evans. Common June to November.

H44. 1. **Curetis thetis** Drury. Common April to November.

4. **Curetis bulis** Db. and Hew. Jungle belt only. October to March.

H45. **Iraota timoleon timoleon** Stoll. One ♂ taken 24–12–38. Mr Gill took 3 (♂ ♂ ♀) at Japaha.

H49. 34. **Amblypodia alemon** DeN. Jungle belt. Flies October to March.

39. **Amblypodia amantes amantes** Hew. Jungle belt. Flies October to March.

H53. **Loxura atymnus.** Jungle belt. One taken October 1932.

H57. 1. **Spindasis vulcanus vulcanus** M. Common March to November.

6. **Spindasis ictis ictis** Hew. Common March to November.

7. **Spindasis elima elima** M. One worn specimen taken July '45.

H58. **Zesius chrysomallus** Hub. Rare. Only females taken. ♂ taken by Mr Gill at Japaha.

H60. 1. **Tajuria jangala ravata** M. Jungle belt. One taken November '33.

18. **Tajuria jehana** M. Rare. One taken only.

19. **Tajuria cippus cippus** F. Appears March to December.

H81. **Zeltus etolus** F. Jungle belt. One taken at Bikhna Thori (Nepal border) December '35.

H84. **Virachola isocrates** F. Taken by Mr Gill at Japaha.

H85. **Rapala schistacea** M. Jungle belt. Flies March to November.

Rapala melampus Cr. Taken at Bagaha September '34. Mr Gill took some at Japaha.

HESPERIDAE

I1. **Hasora badra badra** M. One stray specimen. 4 November '40.

Hasora alexis alexis F. Appears April and July to October. Larvae feed on Beech.

I 5. **Badamia exclamationis** Fb. Flies April to November.

I 26. **Caprona ransonnettii saraya** Doh. Jungle belt. One taken March '35.

I 28. **Syrichtus galba** F. Appears April to October.

I 47. **Suastus gremius gremius** F. Appears June till December.

I 57. **Udaspes folus** Cr. Appears April and August to October.

I 58. **Notocrypta curvifascia** Fd. Jungle belt. One taken March '32.

I 59. **Gangara thyrsis clothilda** Hb. One stray specimen, November '32.

I 64. **Matapa aria** M. Appears about September. October–November.

I 66. **Hyarotis adrastus adrastus** Cr. One taken August '32, one seen October '40.

I 88. 1. **Taractrocera maevius sagara** M. Appears July to September.

I 90. 20. **Padraona phellus phellus** Mab. Jungle belt. Treveni one taken November '32.

I 91. 1. **Astycus augias augias** L. Flies May to October. Common.

2. **Astycus pythias bambusae** M. July to October.

I 97. 30. **Baoris sinensis subochracea** M. One doubtful specimen.

31. **Baoris mathias mathias** F. Flies nearly all the year.

32. **Baoris guttatus bada** M. do. do.

33. **Baoris zelleri cinnara** Wallace. One specimen July '29.

The following additional species, taken in Darbhanga District (N. Bihar) are in the collection of Mr. Chas. M. Inglis, F.Z.S., C.M.B.O.U. None of these have been taken in Champaran.

A 1. **Troides aeacus** Fd. ♀.

A 2. **Tros varuna astorion** Wd. One specimen.

A 4. **Papilio polymnestor polymnestor** Cr. Somewhere in N. Bihar must be the meeting place of this form, and *P. memnon* as I have seen many of the latter.

A 6. **Zetides bathycles chiron**

NYMPHALIDAE

F23. **Abrota ganga** M. This is interesting as the habitat given of this species is Sikkim-Bhutan only. Evidently a migrant and must have flown over 100 miles to where Mr Inglis took it.

LYCAENIDAE

H 8. **Spalgis epius epius** Wd. A local species.

H12. **Tarucus callinara** But.

H14. 1. **Azanus ubaldus** Cr. 27-5-'19, 24-6-'19.

2. **Azanus uranus** But. 17-5-'20.

H17. **Neopithecops zalmora** But. One specimen in 1925.

H18. **Everes parrhasius assamica** (?) Tyt. 23-5-'19, 26-4-'20, 24-3-'21.

H25. **Euchrysops pandava pandava** Hors. One specimen.

H46. **Horsfieldia anita dina** Fruh. 2-3-'20, 29-4-'20, 17-11-20.

H59. **Pratapa cleobis** God. 9-5-'20, ♂♂♀

OBSERVATIONS ON SOME LARVAL AND POST-LARVAL STOMATOPODS*

BY

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(*With two plates*)

SYNOPSIS

1. Habits of larval and post-larval stomatopods of the genera *Squilla* and *Lysiosquilla* were studied by observation on specimens kept in aquaria.

2. The peculiar reactions of the pelagic larvae to light are detailed.

3. The characteristic feeding habits of the larvae and adults are described.

4. Pronounced cannibalistic tendencies are noted in the group.

5. The mechanism of larval and post-larval moults is described and discussed.

6. Eye stalks, as in other crustacea, appear to control the development of chromatophores. Removal of eye stalks does not affect moulting, growth and metamorphosis.

7. Removal of eye stalks a few days prior to final larval moult results in the production of blind albino specimens of post-larvae. The rudiments of post-larval pigments are well laid in the advanced pelagic larva.

INTRODUCTION

Though Stomatopods are quite abundant in the tropics they are generally considered useless as food except in certain places in the Far East where, like prawns, they form an article of human diet. Living usually in burrows and crevices, they are seldom caught in a state in which they can thrive in aquaria and therefore, very little is known about their life habits. Recently Bigelow (1941) has given an account of the habits of *Squilla empusa* Say after his observations on live specimens in an aquarium at Woods Hole.

The observations detailed in the present paper were made when the author was working on the stomatopod larvae of the Madras plankton, at the University Zoological Research Laboratory, Madras[1].

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[1] The paper was written when the author was working at the Fresh-water Biological Research Station, Madras, but was revised and finalised for publication after his transfer to the Central Inland Fisheries Research Station, Barrackpore.

Since specimens of post-larval stomatopods were then being reared in the aquarium tanks, the author had ample opportunities to observe these animals alive at close quarters and study their habits. The author is indebted to Prof. R. Gopala Aiyar, the then Director of the laboratory and also to the University of Madras for the facilities he was given to carry out the work. His thanks are also due to Dr. B. N. Chopra for kindly going through the manuscript and offering valuable suggestions.

FEEDING HABITS OF LARVAE

It has been shown that the late planktonic larvae could be made to metamorphose into the post-larvae in the laboratory and that the post-larval forms so obtained could, with proper care, be grown in aquarium tanks to a fairly large size (Alikunhi and Aiyar, 1942; 1943; Alikunhi, 1944, a, b). The larvae which generally keep healthy in the aquaria are transparent. The feeding habits of these larvae are peculiar. When minute bits of flesh of *Emerita* are introduced into the aquarium the larvae quickly sense the presence of food, show great activity, get hold of the bits by the help of their raptorial claws, hold them firmly at the mouth by means of the maxillipeds and begin to feed while actively swimming. The larvae being transparent, it is interesting that at a casual glance the particles of food appear as moving about apparently by themselves.

In the aquarium, the larva generally swims near the surface but it also frequents the bottom layers. It therefore picks up the particles of food even from the bottom of the aquarium.

REACTION TO LIGHT

The larvae generally show certain definite reactions to light. When placed in a glass trough of sea water and when the maximum incidence of light is on one side of the trough, the larvae are invariably found to crowd on the opposite side of the vessel where there is less light. When the light is obstructed by a piece of paper or even with the palm of the hand, the larvae react almost instantaneously and begin to swim about in the vessel normally in all directions. When the obstruction is removed and the light again allowed to fall fully on the side of the vessel the larvae promptly swim away and crowd on the opposite side as before. While keeping the larvae in the aquaria, therefore, a sheet of brown paper was wrapped on that side of the trough which had the maximum incidence of light so that uniform lighting was ensured in the container and the larvae behaved normally.

MOULTING

It is interesting to note that till now the final pelagic larvae of only a few species of stomatopods (*Squilla empusa, S. quadridens, Lysiosquilla excavatrix* and *L. eusebia*) have been observed to moult into the post-larvae. But even in these species the actual process of transformation into the post-larva has not been described in detail.

Faxon (1882) has seen a larva of *S. empusa,* 17 mm. long, metamorphose into a post-larva, 19 mm. in length. Bigelow (1894) dealing with *S. quadridens,* mentions that 'in the passage from the larval to the adult form the body becomes broader and more compact at the expense of its length, so that shortly after the moult it is but 1.1 cm. in length, while before it was 0.5 cm. longer'. Giesbrecht (1910) observes that the final pelagic larva of *S. mantis* and *S. desmaresti* measures 20-22.5 and 21-22.5 mm. respectively, while the first post-larval stage measures 17-18 and 16 mm. respectively. My own observations also go to show that there is a definite reduction in length following the final larval moult, particularly in the larvae of the *S. nepa* and *S. quinquidentata* groups in which the pre-labial region is highly telescoped. Instances, however, are not wanting where the reduction in length is rather insignificant as in the short, stout larvae of the small-eyed species of the 'Chloridella' group. As noted by Bigelow, generally, during transformation from the larval to the post-larval stage the body becomes broader and stouter at the expense of its length.

All the species of stomatopod larvae commonly occurring in the Madras plankton have been correlated with their adults by rearing the planktonic larvae and metamorphosing them into the post-larvae in the laboratory (Alikunhi—unpublished). Observations on larval and post-larval moults could, therefore, be made on 12 species of the genus *Squilla* including the common forms *S. nepa, S. holoschista, S. wood-masoni* and *S. raphidea,* and on three species of the genus *Lysiosquilla* namely *L. maculata, L. tigrina* and *L. multifaciata.*

Time of Final Larval Moult.

Larvae which are in the final pelagic stage could be recognized under the binoculars by the outline of the post-larval carapace and telson that is clearly visible through the transparent larval exoskeleton. This outline of the post-larval body appears only in the final pelagic stage. Such larvae, if kept in fresh sea water aquaria, are invariably found to metamorphose into post-larvae during the night. It is remarkable that the frail, transparent pelagic larva transforms itself into a totally different post-larva overnight, in the course of 6 to 10 hours after definition of the post-larval body outline.

To ascertain whether darkness had any particular effect in hastening the final larval moult and metamorphosis, 18 specimens of the final pelagic larvae of *S. nepa* were placed in the morning in an earthenware vessel containing fresh sea water and the vessel was kept covered to avoid all light. Examination at 1 p.m. and at 4 p.m. showed that the larvae remained unchanged. By next morning however, 15 of the larvae had metamorphosed. Similar larvae, from the same collection kept in a glass trough of sea water, also metamorphosed overnight, and the early post-larvae in both the cases were identical in the intensity of pigmentation, etc., showing that both the groups had metamorphosed almost at the same time. On other occasions also, larvae picked out from the tow-net collections in the morning and kept in glass aquaria, metamorphosed into post-larvae only during the night. It might, therefore, be inferred that in the open sea also the final moult and metamorphosis normally take place at night, though darkness by itself does not appear to have any particular effect in hastening metamorphosis.

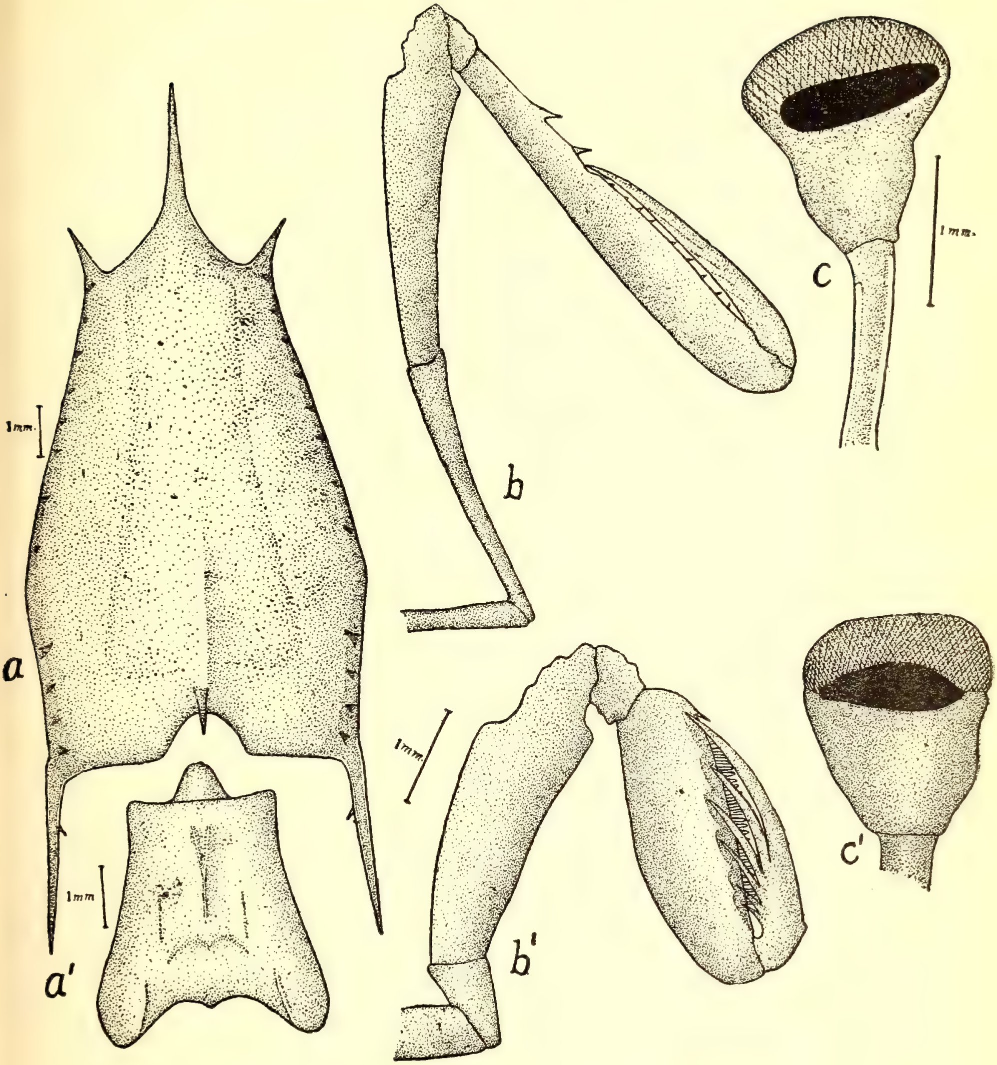
In the laboratory the final larval moult invariably took place after 10 o'clock in the night. Unfortunately, the actual process of moulting could not be observed in detail, but the complete moults and a series of specimens in the different stages of moulting have been collected so as to furnish a full account of the process.

Final Larval Moult and Metamorphosis.

The following observations were made on larvae of *S. nepa* but the statements are equally applicable to other species of stomatopods occurring on the Madras coast.

It is interesting to note that while the general broadening of the post-larval body is effected at the expense of its length, in the case of the carapace, only a narrow median strip of the larval structure takes part in the transformation into the post-larval carapace (Plate 1, a-a'). This median strip is clearly indicated in the final pelagic larva, but is more than double the length of the post-larval carapace. During moulting the larval carapace, together with the peripheral skin falls off, exposing the median soft skin which soon gets hardened. It is thrown into a series of folds anteriorly, thereby getting shortened. With the quick hardening of the new carapace the folds also disappear and finally the general shape of the adult carapace is assumed. While these changes are taking place, the terga of the last three thoracic segments split longitudinally in the middle and through the opening so formed the soft post-larval body which by then is free from its larval coat, is gradually drawn out by a series of convulsive movements of the abdominal segments. Quickly following this the anterior limbs are also pulled out of their larval covering. On completion of this casting off of the larval skin, the post-larval body, being very soft, quickly undergoes some shortening. The region between the antennae and the labium and the last three thoracic segments get considerably shortened and assume proportions totally different from those in the larva. With the hardening of the new skin, the various organs show a closer approximation to the adult condition than in the previous larval stage. During this quick process of transformation the following changes, besides the general broadening of the body and the formation of the new carapace, are conspicuous: The eye stalks become short and stout, with the cornea set more in the fashion characteristic of the adult (Plate 1 c-c'). The raptorial dactylus becomes provided with a series of well-developed free spines which were just visible through the transparent skin of the pelagic larva (Plate 1 b-b'). The last three thoracic segments get conspicuously broadened and their lateral sides are provided with characteristic processes (Plate II a-a'). The pleopods which in the larva had the gills in the form of compact bundles, now have them branched and finely plumose (Plate II b-b'). The telson and the uropods largely approximate to the adult condition (Plate II c-c').

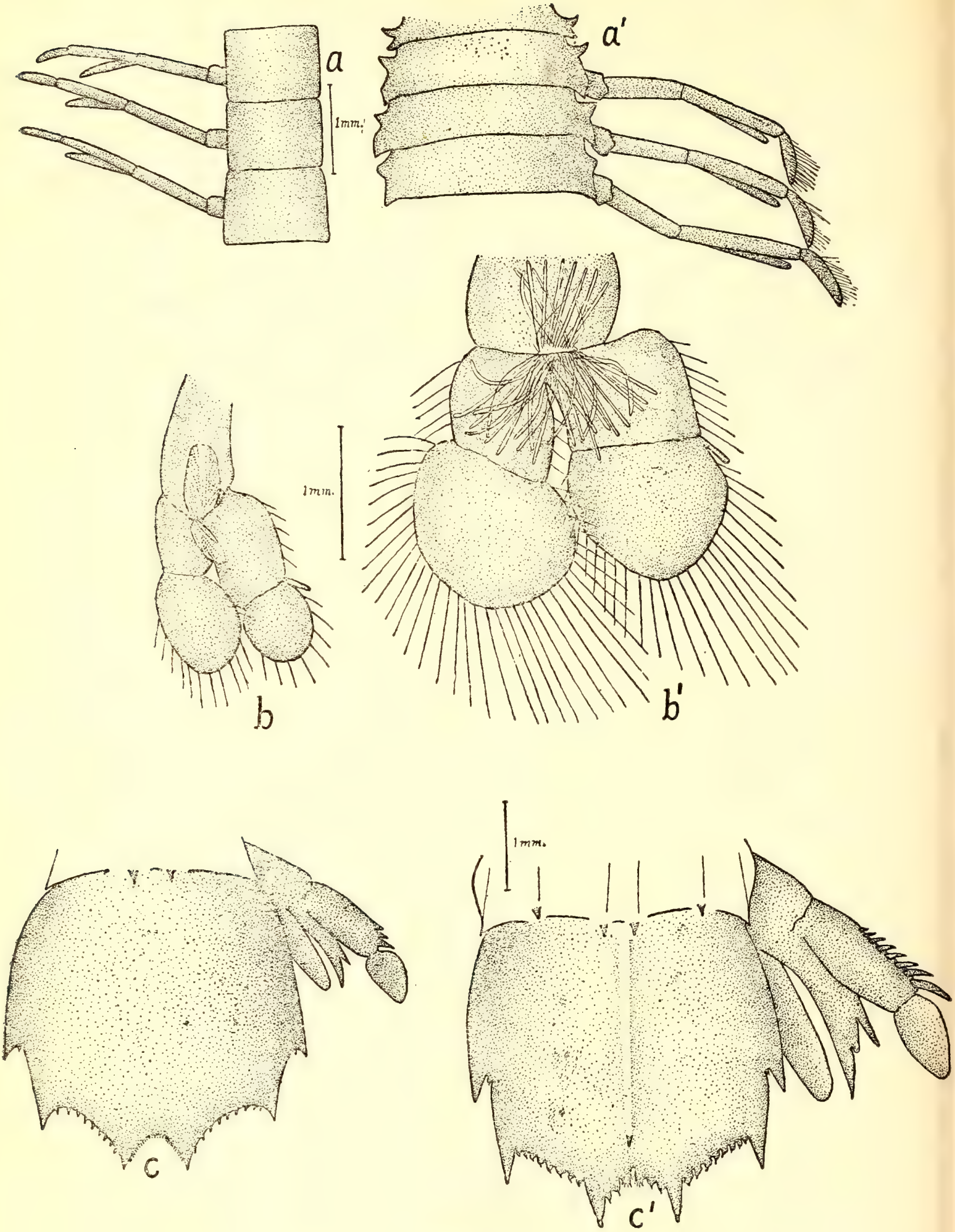
The frail body of the pelagic larva is singularly transparent and generally devoid of pigment. The early post-larva has the body



Squilla nepa

Modification of structures during metamorphosis from pelagic larva to post-larva

a. Carapace of final pelagic larva ; a′. Same of early post-larva.
b. Raptorial claw of final pelagic larva ; b′. Same of early post-larva
c. Eye of final pelagic larva ; c′. Same of early post-larva.



Squilla nepa

Modification of structures during metamorphosis from pelagic larva to post-larva

a. Last three thoracic segments of final pelagic larva ; a'. Same of early post-larva.
b. Pleopod of final pelagic larva ; b'. Same of early post-larva.
c. Telson and uropod of final pelagic larva ; c'. Same of early post-larva.

opaque and several chromatophores are now distributed all over the dorsal body surface, often forming definite patterns. With metamorphosis the pelagic existence is also abandoned and the post-larva confines itself to the bottom of the aquarium.

It is of interest to note that while most of the changes undergone during the final larval moult are already heralded by the more or less distinct outlines of post-larval structures in the late pelagic larva, the very conspicuous transformation from the larval to the post-larval body is remarkable in that it is achieved in the course of a relatively short period of 6 to 10 hours.

Post-Larval Moult.

Post-larval specimens kept in the aquarium and regularly fed, undergo the first moult within 4½ to 6 days after metamorphosis. Unlike the final larval moult, the post-larvae moult during any time of the day or night. It may be mentioned that early *Alima* larvae also when kept in aquaria, moult into later stages during day time.

The post-larva when about to moult, becomes less active and repairs to a quiet corner of the aquarium. The body then appears less bright than before. The process of moulting is essentially the same as in the pelagic larvae. The terga of the last three thoracic segments split longitudinally in the middle, the abdominal portion is first drawn out of the old coat through the opening so created, the carapace comes off and falls away or sometimes may remain connected with the rest of the moult by the anterior end, and finally the cephalic and thoracic appendages are also freed from their old covering. Occasionally when the abdominal moult is completed, the specimen begins to swim in an excited fashion (with the slough trailing) trying to get the anterior limbs also free. It soon falls to the bottom as if exhausted.

Immediately after moulting since the chitinous covering has not hardened, the specimen is rather weak and unable to move about actively. It often swims by an awkwardly synchronised movement of the limbs and then more or less passively falls to the bottom. During this period it is completely helpless and highly vulnerable to attacks by enemies. Cannibalism is rather pronounced in the group and if more than one specimen are kept in an aquarium and if any of them undergoes a moult, it usually falls an easy victim to the predatory leanings of its brethren. This destructive tendency is manifested also when specimens of different sizes are kept together in an aquarium, the smaller ones being preyed upon by the larger.

The mechanism and periodicity of larval and post-larval moults are similar in the genus *Lysiosquilla* also.

FEEDING HABITS OF POST-LARVAE AND ADULTS

The early post-larvae continue to live and grow in the aquaria provided the water is daily changed and they are regularly fed with suitable food. In the present series of experiments, the mole crab *Emerita asiatica* which occurs in large numbers in the inter-tidal zone of the Madras beach, was found to be quite an agreeable food for the post-larvae. Feeding can be effected either with live specimens or with minced meat, depending on the size of the post-larvae. For young specimens small bits of the soft parts of the body of the crab are preferable. Older specimens will readily feed when small live *Emerita* are introduced into the aquarium. The food is promptly caught with lightning rapidly by the powerful raptorial claws, and the maxillipeds by a quick movement grab the same and hold it in position at the mouth when the mandibles begin to work at it. Soon the entire bit is taken in and can be seen from the dorsal aspect as a light brown mass inside, at the level of the anterior half of the carapace. In the case of older post-larvae it is very often noticed that while several of the crabs are caught and killed none of them is completely eaten up, but in every case about 1/3 of the body at the junction between the cephalothorax and the abdomen alone is eaten. This happens to be the softest portion of the body of the mole crab. The live *Emerita* is often pursued by the post-larva and repeatedly slashed with the raptorial claws, before it is actually caught. To observe the specimens feeding is really very instructive and on one occasion there was in the aquarium a specimen of *Lysiosquilla maculata* which was apparently conscious of the usual feeding time and which had the peculiar habit, on getting hold of a bit of food, of lying at the bottom of the aquarium on its back, with the head and tail curved up, busily engaged in munching at the morsel.

Albino Specimens

That in the eye stalks of crustacea are situated the centres which control the development of chromatophores over the body could be clearly demonstrated in the case of stomatopods also. But for a few yellow chromatophores on certain regions of the body and the characteristic reddish tinge in certain species, pigment is generally absent in stomatopod larvae. However, in the course of about 12 hours during which the final larval moult resulting in metamorphosis into the post-larva takes place, numerous chromatophores make their appearance, all over the body.

Active, final pelagic larvae of *S. holoschista* were taken and the eye stalks were chopped off. On releasing into water they began to swim about in an aimless fashion. By next morning like the normal larvae, they metamorphosed into post-larvae. These however, were pale white in colour. Under the microscope the chromatophores over the body appeared as minute dots unlike the normal post-larvae in which the chromatophores are generally large, blotch-like, stellately branched or irregular. The arrested development of chromatophores results in almost albino specimens. In other respects they behave normally; they take food when they come across the same and thrive in the aquaria.

A few advanced larvae, not quite in the final pelagic stage, were subjected to similar experiments. Three days after the removal of eye stalks the larvae moulted and metamorphosed into post-larvae which were more or less perfect albinos. Chromatophores were either absent or if a few were present, they were extremely minute and inconspicuous. Fed regularly, these post-larvae also thrived in aquaria and moulted regularly like the normal specimens. After the second post-larval moult a small feeler like structure appeared in place of the eye. The much pigmented *L. maculata* also behaves likewise, and if eye-stalks are removed the final pelagic larvae metamorphose into post-larvae which are devoid of pigment.

It is clear from the above that even though the frail pelagic larvae are transparent, the rudiments of post-larval chromatophores are well laid even before the final pelagic stage and their further development is arrested by the removal of the eye stalk. The removal of the eye stalk does not adversely affect the specimens in any way other than in inhibiting pigmentation.

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OBITUARY

H. B. HAYES

Hugo Basil Hayes who died in Bombay on the 7th January of this year at the age of 57 was a member of the Society since 3-1-1943 during which time he served on the Executive Committee from 5-6-1947 to the time of his death.

His wide and varied experience of both big and small game shooting and fishing in Northern India, Bihar, Orissa, Bengal and Bombay was unrivalled. Unlike most of us who laid on expensive bundobast for shikar trips, with tents, carts and servants, Mr. Hayes would rough it in true style; a small box of stores, a stove for cooking and perhaps a camp-cot, and he would go off into the forests in pursuit of his most cherished sport, be it shooting or fishing, or both, mixing and living with the jungle people, who held him in high esteem.

Unfortunately he kept no diary of his many years of shikar excursions, but to spend an evening, or a few days with him in a camp was a joy. He had the gift of relating shikar experiences, without being boring or repeating himself. To see him get down to cooking a meal and then washing up after a long day, at his age, was indeed a fine illustration of the old school, and an example to many of us younger men.

His great charm lay in his unselfishness and his kindly help to strangers. My own acquaintance with him only developed in 1944, while stationed in Bombay, when through an introduction from the Society, I came to know him and got the benefit of his experience of both the fishing and shooting around Bombay, besides introductions to others interested in the sports I sought myself.

The foundation of the Bombay Presidency Angling Association with its headquarters at Powai Lake near Bombay and the introduction of the fry of Rohu, Mirgil and Catla from Patna in 1935-1936 will remain a monument to his great services to the angling fraternity in Bombay. Good catches and huge fish have been recorded in the past four or five years, after he introduced tank angling methods, so well developed in Bengal but hardly known in Western India.

His death will be felt by his many friends, and the Society loses a valuable and able field naturalist, a progressive worker, and a fine sportsman and gentleman.

A. St. J. M.

REVIEWS

1. EXTERNAL AND INTERNAL ANATOMY OF THE BUFFALO-LOUSE, *Haematopinus tuberculatus* Burmeister. By M. A. H. Qadri, Aligarh Muslim University Publications, Zoological Series, 1948. Price Rs. 3.

It was not long ago that even the so-called university lectures were all calculated to prepare students merely to answer questions of the type 'Write short notes on'. At least in chemistry there are excellent text-books published in India, to mention two on Organic Chemistry, from our own province, one by Karve and Advani, the other by Nadkarni and Kothari. No book of a similar standard has appeared in zoology from any centre of teaching in India and the reason is not far to seek. Indian types of animal life have not been studied properly. I believe Prof. B. Mirza even as a student, discovered that the earthworm given for dissection in India did not correspond with the type described in English text-books. His attention having been thus drawn early, he has given the consideration that the study of biological types rightly requires, for it is only such monographic studies that can be subsequently incorporated into text-books of Indian zoology.

Perhaps of all types specific to a country the foremost amongst them belong to insects. Prof. Baber Mirza of Aligarh has therefore announced several monographic studies on Indian insects, the one under review being the first of the series. Here Dr. Qadri deals with the Buffalo-louse, *Haematopinus tuberculatus*. The contents cover 20 pages, with an additional page of 20 references and 9 plates containing 20 illustrations. The printing is excellent. The illustrations, which were done in pen and ink, are reproduced on art paper, which, in these days of paper shortage seems a luxury rather than a necessity. The price is Rs. 3 but appears reasonable considering the present cost of paper and printing. The contents represent a good average of the type of research work done in Indian universities.

Dr. Qadri cites, among others, the monograph of H. Sikora on *Pediculus vestimenti*. She was a mere artist working for Prof. von Prowazek of Hamburg, and the work indicates what a lady-technician can do in Germany even during her spare time. She discovered an organ containing symbiotic bacteria which she named 'Magenscheibe'. Ries (*Zeit. Morph. Ok.*, 1931, **20**: 147) went further into its details and included in his thesis observations on more than one species of *Haematopinus*. Unfortunately no mention is made of this monograph by Ries nor even to symbiosis.

S. MAHDIHASSAN

2. WILD FLOWERS AT A GLANCE. By M. C. Carey and Dorothy Fitchew. Pp. xi + 275, plates 264; 17.5 × 11 cms. London, J. M. Dent & Sons, Ltd. (1949). Price 10*s*. 6*d*.

This is one of the finest books written for the public at large; botanical terminology has been reduced to the minimum, and even the few terms used are clearly explained in the introduction. For easy reference, plants are grouped according to the colour of their flowers, and within each colour-group plants are arranged following the system of Bentham and Hooker in their British Flora. Each plant is fully illustrated in colour and has in addition a clear and simple description. Other interesting details given are the places where the plant is found, the districts in the British Isles where the plant is common, the time of flowering, the total height of the plant, and short notes on the derivation of the Latin name. The colour plates are a joy to see and botanically perfectly accurate. An index of English names closes the book. A novel departure in such popular books is the addition of a clear cut scale in inches embossed on the back cover of the book; such a scale is often a necessity in the field, and the publishers have done a good service to the forgetful tribe of botanists in attaching such a scale to the book. The price is very moderate considering the large number of colour plates and the excellent printing and binding of the little volume. Without hesitation I recommend this book as a present for school children and their elders. The study of the flowers of the field with the aid of this book becomes such a real pleasure that the book could very properly be called 'Botany without Tears'.

H. SANTAPAU

3. THE OCEAN. By F. D. Ommanney, Ph.D., A.R.C.S., F.L.S. Pp. ix and 1-238 with Plates I-IV and text figures 1-12. Oxford University Press, 1949. Price 5*s*.

This book forms volume No. 203 of The Home University Library of Modern Knowledge, and is in no way inferior to the many excellent little volumes already published in the series. The ten chapters of the book read like a story; they are written in very simple style and without the cumbersome technical terminology often found in such books. Chapter II deals with *Life in the Sea* and discusses the very controversial point of the origin of life; 'there is no direct evidence as to how or where life first began on earth . . . The sea is so excellently suited to the development and maintenance of life that it is natural to look upon the shallow coastal seas as its birthplace and cradle'; with such charming scientific honesty no reader need pick up a quarrel. In subsequent chapters the author discusses the various kinds of life in the sea, beginning with the lowliest; the importance of plankton is very properly stressed forming as it does the basic food on which higher sea animals depend. The printing of the book is of the very highest standard and the text figures are select and clear. At the end of the book there is a short but very select bibliography, in which the names of a number of recent books on the subject are listed with short notes on their contents and method of dealing with the subject. This is a book that ought to be read by every one who is interested in the general subject of biology, and in the fascinating chapter of life in the sea.

H. SANTAPAU

4. BIRDS OF THE COAST. By C. A. Gibson-Hill, M.A., M.B.O.U. Pp. 216. 16 plates; numerous sketches and distribution maps. London, H. F. and G. Witherby Ltd. (1949). Price 10/6 nett.

Though one of the numerous books that continue to be written about British birds, this is outstanding in so far as the author fairly establishes his contention in the preface that the description of key points assisted by black and white line drawings are often more valuable for recognition than coloured plates. While weather conditions in India do not ordinarily force us to attempt identification in rain, snow and fog, we must admit that many of the numerous comparative sketches in this book are clearer and more helpful than detailed descriptions.

As the title implies, it deals mostly with ducks and geese and the wading birds, followed by gulls and terns. But a few of the passeres and birds of prey are also included. With the large variety of coastal birds visiting India in winter, we sadly lack a work of this nature and it is to be hoped that somebody who can sketch birds well will make an attempt to fill the deficiency in the near future. Finn's 'How to know the Indian Waders' was a good effort for its time, but a modern work with illustrations of this type would be very welcome. One cannot conclude without reference to the amazing versatility of the author mostly in connection with oceanic birds but also covering various other forms of life. The name re-appears in journal after journal always accompanied by excellent photographs and sketches and we hope that we will have his writings more often on forms nearer to us.

H. A.

The following books have been added to the Society's Library since August 1949:—

1. THE MARINE PELECYPODA OF BOMBAY. By T. V. Subramanyam, K. R. Karandikar & N. N. Murthi—A Reprint from the Journal of the University of Bombay, Vol. XVIII, Pt. 5, March 1949.

2. ON INDIAN INSECT TYPES—External and Internal Anatomy of the Buffalo-louse, *Haematopinus tuberculatus* Burmeister. By M. A. H. Qadri. Aligarh Muslim University Publication (Zoological series). Edited by Dr. M. B. Mirza 1948 (A Review copy).

3. WILD FLOWERS AT A GLANCE (with more than 260 illustrations of wild flowers in full colour). By M. C. Carey & Dorothy Fitchew (J. M. Dent & Son Ltd., London, 1949) (A Review copy).

4. THE OCEAN. By F. D. Ommanney (Oxford University Press, 1949) (A Review copy).

5. PROCEDURE IN TAXONOMY—Including a reprint of the International rules of Zoological Nomenclature with summaries of opinions rendered to the present date (1907-1947). Completely indexed—Revised edition. By T. Edward Schenk, H. John McMasters. Revised and enlarged and in part written by A. Myra Keen

& Williams Siemon Muller (Stanford University Press, California 1948).

6. SOME VERTEBRATE ANIMALS OF CEYLON—Pictorial Series. Vol. I. By P. E. P. Deraniyagala. The National Museums of Ceylon. (Colombo, 1949).

7. BIRDS OF THE COAST. By C. A. Gibson-Hill (H. F. & G. Witherby Ltd., 5, Warwick Court, London, W.C. 1, 1949).

8. TROPISCHE SCHMETTERLINGE (Tropical Butterflies). By Ernst Rütimeyer & Viktor Schütz (Hallwag A. G. Bern, 1947).

9. ANNUAL REPORTS OF THE DEPARTMENT OF FISHERIES, BARODA from 1937-1938—1947-1948. By Dr. S. T. Moses.

10. BULLETIN OF THE DEPARTMENT OF FISHERIES, BARODA STATE, Nos. 1-16.

Bulletin No. 1 of 1940 Fish-culture in and around Kosamba. By Dr. S. T. Moses, 1940.

Bulletin No. 2 of 1940 Cold Storage of fish and its potentialities in Baroda. By Dr. S. T. Moses, 1940.

Bulletin No. 3 of 1940 A Statistical Account of the fish supply of Baroda City. By Dr. S. T. Moses, 1940.

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Bulletin No. 5 of 1944 The Fresh-water Prawns of Baroda. By Dr. S. T. Moses & P. H. Joshi, 1944.

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Bulletin No. 7 of 1945 Decomposition & Putrefaction of fish. By Dr. S. T. Moses, 1947.

Bulletin No. 8 of 1946 *Dermestes vulpinus* F.—An Insect pest on dried fish. By Dr. S. T. Moses, 1947.

Bulletin No. 9 of 1946 Development of Indian Fisheries: Objectives & Requirements. By Dr. S. T. Moses, 1947.

Bulletin No. 10 of 1947 Whales in Baroda (*Orca* Stranded at Aramda in 1943 and *Balaena* at Ganjana in 1944). By Dr. S. T. Moses, 1947.

Bulletin No. 11 of 1947 Baroda Fisheries. By Dr. S. T. Moses, 1947.

Bulletin No. 12 of 1947 Pearls & Pearl Fisheries in Baroda State. By Dr. S. T. Moses, 1947.

Bulletin No. 13 of 1947 A Preliminary Report on the Cephalopods of Baroda. By Dr. S. T. Moses, 1948.

Bulletin No. 14 of 1948 A Preliminary Report on Mushrooms of Baroda. By Dr. S. T. Moses.

Bulletin No. 15 of 1948 Crocodiles in India. By Dr. S. T. Moses, 1948.

Bulletin No. 16 of 1949 Sea-Weeds of the Baroda Coast. By Dr. S. T. Moses & T. V. R. Pillay, 1949.

MISCELLANEOUS NOTES

1. LONGEVITY IN ELEPHANTS

In connection with a recent note of Mr. N. G. Pillai's relating to the age of elephants (*J.B.N.H.S.* 48: 356), I have a recollection of reading that the elephant ridden by the Prince of Wales (later Edward VII) in 1876 in Delhi was the same as was used in 1803 by Lord Lake in his triumphal entry into the Imperial Mogul-Maratha capital. Is this a fact?

'SOUTHWOOD', MUSSORIE, U.P. HAMID A. ALI
10th November, 1949.

2. WILD ELEPHANTS DYING IN ASSAM

In August and September 1949 some brief reports appeared in the press of wild elephants dying in the North Cachar Hills of Assam. I immediately made enquiries, and thanks to the co-operation extended to me by Mr. P. D. Stracey, Senior Conservator of Forests, and Mr. M. N. Pait, Divisional Forest Officer of Nowgong District, I am able briefly to give a few facts about the case.

The epidemic apparently started about the first week of June, and lasted up to the second week of July. There was a spell of hot weather during this period. The area affected was the Langting-Mupa Reserved forest and the strip of Unclassed State Forest to the east of it, an area of some 20 miles by 15 miles to the south of Lumding railway station.

A fair number of tusks of tuskers and tushes of makhnas and females have been brought in, and the latest estimate of the D.F.O. of Nowgong is that approximately 55 elephants must have died. It is believed that two or three herds were affected, and that mortality was greatest among the younger animals. The carcases of the dead elephants were found chiefly in nine different places inside the area referred to above. There is no news of any other wild animals such as deer or bison having died.

The epidemic is believed to have been anthrax, but unfortunately there is no proof, as no vet seems to have been available at the time. In the early part of June there was an outbreak of the epidemic at two villages to the east of Langting station, with heavy loss of domestic buffaloes. It is not known if the elephants nearby contracted the disease from the buffaloes, or vice versa.

It is an extraordinary thing that ten years ago a similar epidemic occurred in the North Cachar Hills, in which elephants, bison and sambar are reported to have died in considerable numbers in the upper Kopili area of Garampani. Some 29 elephant tusks were recovered from a comparatively small area round the hot springs. The epidemic raged from April 1939 till September of that year, and the large herds of bison of the Krunming Reserve were said to have been practically wiped out. The Sub-Divisional Officer of the North Cachar Hills at that time tells me that the disease seems to have been a form of rinderpest, but that there is no accurate information on the point. Other such epidemics have taken place in Assam, such as in the Kochugaon Forest of Goalpara District in 1933, when some 20 bison are reported to have died, and in Kaziranga Game Sanctuary in 1947, when 14 carcases of rhino were picked up (many more may have died, and no trace of them found).

An enquiry is to be held in the North Cachar Hills in the near future, and it is to be hoped that more information will become available. In the meantime all elephant catching operations in that particular district have been cancelled.

DOYANG T.E.
OATING P.O., ASSAM,
25th December, 1949.

E. P. GEE

3. A BULL BISON'S ABNORMAL BEHAVIOUR

On returning to my estate after 5 days' absence, on the 14th December I was informed that a large solitary bull bison had visited my cart-bulls shed (surrounded by coffee) on the 13th and 14th, demonstrating at the graziers. On the 15th I received word that the same bull was grazing in my new coffee clearings, and again showing hostility to the graziers on the grass slope nearby. On arriving at the place I, sure enough, found the bull on the borders of the new clearing and, on seeing me the bison at once walked towards me in a most menacing manner. There was little doubt as to his intentions and I shot it; a large brute, blind in one eye (the eye was missing). It is just possible this may have accounted for his ill-temper and curious behaviour.

HONNAMETTI ESTATE,
ATTIKAN P.O., VIA MYSORE (S. INDIA)
20th December, 1949.

RANDOLPH C. MORRIS

4. THE LARGE RED FLYING SQUIRREL—*PTEROMYS INORNATUS* GEOFFROY

Not much seems to be on record concerning the life and habits of this squirrel. Early in my service from the year 1890 onwards I held charge of the Jaunsar Forest Division, with Chakrata as my head-quarters. My charge included the leased forests of Tehri Garhwal in Tons valley from its junction with the Jumna river at 1,000 feet altitude up to about 13,000 feet. The forests were mostly coniferous. At low levels there were extensive areas covered with the Chir Pine (*P. longifolia*). Above 5,000 feet came the Blue Pine

(*P. excelsa*) mixed with oaks of two kinds and from 7,000 feet up to about 9,000 feet, Deodars, spruce firs and silver firs predominated, with the high level Karshu Oak. Above 10,000 feet the forest growth consisted of the high level silver fir, birch and rhododendron, etc.

The flying squirrel was not rare throughout this area. In the summer months they frequented the fir and oak forests between 7,000 and 9,000 feet. They are nocturnal in their habits but in undisturbed forest may often be seen on the move in the dusk after sunset. They are, however, more often heard than seen, the cry being a rather loud, penetrating and drawn-out whine.

The only nests I found were similar to the English squirrel's dray, a nest as big as that of a crow made of sticks and vegetable matter. They have one young only.

A young one taken by me in May from a nest in a spruce fir about 30 feet from the ground was unfortunately hardly old enough to survive, and in spite of artificial feeding it died in a few days.

Their food consists I believe entirely of seeds chiefly acorns and other fruits and leaves. They will take long flights, if necessary, by gliding down the mountain side.

On one occasion I was standing in open fir forest near a forest rest house at Deota. It was growing dusk. Suddenly I noticed a flying squirrel sitting motionless on an excrescence from a spruce fir about 2 feet from the ground. The animal was watching me and evidently thought itself safe as it had the tree trunk at its back, up which it could disappear if necessary. I began to advance on the squirrel very gradually and the animal seemed to think all was well. When only about 3 or 4 feet off I sprung forward and managed to seize it in both hands as it endeavoured to run up the trunk of the tree. I gripped her firmly and managed to avoid being bitten. I took her up to the house and put her in a strong basket with a lid for the night. In the morning I found she had eaten her way out of the basket and was loose in the room. I captured her and took her out intending to make her climb a tree and see how far she would glide. There was no difficulty in inducing her climb up a small spruce tree about 30 feet high. The tree was near the head of a fairly steep valley leading down from 7,500 feet (Deota) to the Tons river at 3,500 feet. I now endeavoured to persuade her to take off. She refused for some time but eventually gave in. I expected her to fly perhaps 100 feet or so and to alight on some big tree below, but to my surprise she glided away right down the steep valley. She was visible for only about 100 yards when the valley curved. When I last saw her she showed no signs of alighting and I imagine she may have continued her downward course for a very long away. She was doubtless scared and wanted to put a considerable distance between herself and her enemy.

In the year 1892 I was living in Naini Tal. During my stay there, a forest working-man brought me a young flying squirrel. It seemed to be nearly full grown and was in good health. I was leaving for England in a month or so, so I made arrangements to take her (for she was a female) with me. I had a cage made and in due course started off for Bombay with the squirrel in the cage and with a small sack of apples.

The squirrel was very fond of apples and fed well on the journey but felt the heat (it was July) intensely. I gave her a big lump of ice in her cage which she much appreciated. Eventually I got her safely on board ship and she survived the voyage and arrived at my home in Sussex in very good condition. At first we housed her in a small room in the tower above the house but she was not very happy there, so she was relegated to an old glass house—a fernery where she had lots of room. She lived in this house for over a year being fed on apples, nuts, pie crust and other fruits.

In the meantime I had to return to India and my mother took her in charge. She fed her every day.

When I returned two years later she was still in good health and fairly friendly. One evening in July we heard her calling in the park. We ultimately traced her to a big oak tree. On examining the fernery we discovered a hole in the roof through which she had evidently been in the habit of going out every night to feed on apples or acorns, and then returning in the early morning. We did not block up the hole and she returned as before. For some time she continued her nocturnal visits to the park and garden and eventually she strayed away and was ultimately found dead in Petworth, 4 miles away, probably shot by some 'sportsman'. Had we had a pair of these squirrels I feel sure they would have done well and probably would have bred, but I am inclined to think they could not survive the winter in England unless fed, as I do not think they store up food in autumn.

There is another large red flying squirrel which occurs in the submontane sal forests of the tract from Jumna to Nepal. I saw it on several occasions and it seemed to me to be exactly similar to the one above described. The only one I saw at close quarters was when I was sitting up in a machan in the Bahraich sal forest. There was a tiger kill under my machan and I was keeping very quiet as the time had come when the tiger should return. Suddenly there was some smack on the tree just above my head not 2 feet away where a flying squirrel had alighted having doubtless glided down from some distant tree. It gave me a jump! I do not remember if the tiger returned or not.

It would be interesting to ascertain if this large flying squirrel which inhabits the submountane sal forest is, or is not, the same as the high level Himalayan species. Possibly the Bombay Natural History Society may have specimens from both localities and could settle the question?

116, BANBURY ROAD,
OXFORD, B. B. OSMASTON
28th November, 1949.

5. SCENT

Some sportsmen are apt to underrate the power of scent possessed by certain animals. The tiger and the domestic cat are two instances.

In the article on the Indian Wild Dog published in the Society's *Journal* Vol. 41, No. 4, the writer remarked at page 710 that the scenting power of the species is extraordinary as shown by the fact that the animals can follow a line in the hot weather when the ground is bone dry. They have been observed doing this during the hottest hours of the day when the temperature is around 110° Fahrenheit.

This power of scent possessed by the Indian Wild Dog is superior to that of most domestic dogs; but that in exceptional instances the trained Alsatian dog can perhaps more than equal it is evidenced by the doings of 'Captain Hall', the Alsatian so named by the Egyptian Police after his former English owner. The dog was three years old when taken in hand, and though born of untrained parents took to the work at once and proved to be of amazing intelligence.

In his most interesting and informative book, 'Egyptian Service—1902-1946.' Sir Thomas Russell Pasha, K.B.E., C.M.G. relates how this dog, among many and remarkable cases, showed how he was able to follow a scent several days old, and even on a tarmac road over which motor cars had been passing for some hours after the scent had been laid.

In one case every detail was personally known by Sir Thomas Russell as the Senior Police Officer in close connection with the murder of his shikari, Guda. The dog Hall arrived with his handler four days after the murder, and having had his nose pressed down to the foot imprint of one of the three suspects picked the man out from a number of men lined up in two ranks for his inspection. He was then taken back to the place in the desert where the naked body of the murdered man had been buried by the murderers and repeated the process by detection of a second man in the identification parade; being once more taken to the graveside he repeated the feat by singling out the third suspect. Although the previous two were still in the ranks he passed them by and seized the third man.

The tracks from the village hamlet to the desert grave showed that a donkey had been used for conveyance of the corpse. The five days old back track from the grave to the village was followed by the dog which disregarded everyone of the many other overlying tracks and led the following party of police and others to the hut where the man had been strangled. For the first seven kilometres the ground was soft and still showed the track, but a kilometre from the desert edge sand and gravel gave way to flint and rock yet the astounding dog took the track over a mile of stony country, over ground fouled by the tracks of village flocks and herds and getting yet more foul as it approached the village. Slowly he puzzled out the line, took it half round by the outer wall of the hamlet, in and along the village street, sniffing at each door till he found the house he wanted when he gave tongue and demanded entrance.

This wonderful instance of power of scent and sagacity is here related with presumed permission of the distinguished author in whose book are also instances of the marvellous tracking powers of some Arabs. In Upper India also there are people who can perform very wonderful feats of tracking as is well known to the police of those parts of the country.

BANGALORE,
November 1949.

R. W. BURTON,
Lieut.-Col. I.A (Retd.)

6. THE SOUTHERN LIMIT OF THE RED JUNGLEFOWL (*GALLUS G. MURGHI* ROBINSON & KLOSS)

I was always under the impression that on the east coast the Grey Junglefowl was found south of the Godavari river and the Red Junglefowl north of the river. Recently I have shot Red Junglefowl at Polavaram on the right bank of the river and also at Devipatnam on the left side of the river immediately opposite Polavaram. When at Bhadrachellam shooting on the left bank of the river I was rather surprised to find Grey Junglefowl in this area and two very fine cock birds were shot.

c/o THE INDIAN LEAF TOBACCO
DEVELOPMENT CO. LTD.,
POST BOX NO. 20, A. J. BROCK
RAJAHMUNDRY,
16th December, 1949.

[The Godavari river above Rajahmundry has so far been accepted as the southern limit of the range of the Red Junglefowl. Jerdon writes that he has heard of its being shot further south at Cummum (Cumbum?), but adds that he cannot vouch for this record. Jerdon also says that on the Indravati, not far from its junction with the Godavari, both the Red and Grey Junglefowl were heard crowing a few yards from each other. In the *Journal* (Vol. 40, p. 379) Sálim Ali and Humayun Abdulali have referred to a sight record by Mr. C. McCann near Bombay and have subsequently seen a young cock tethered in captivity said to have been raised from eggs taken at Khandala, Western Ghats. It might be interesting to draw attention to the fact that Jerdon (Vol. 3, p. 537) refers to Blanford informing him of its occurrence in the Rajpipla Hills, south of the Nerbudda, though this is completely ignored in Blanford's Fauna published 35 years later (1898).

In the main however, it seems to be true that the distribution of the Red Junglefowl in India coincides in a striking measure with that of the sal tree (*Shorea robusta*). The ecological factors governing this parallelism need to be determined.—EDS.]

7. OCCURRENCE OF THE BLUE-BREASTED QUAIL [*EXCALFACTORIA CHINENSIS* (LINN.)] IN MYSORE

Can you help me out over the identity of a quail? It had an outstanding bright red eye and this being so I did not make a careful note of the rest. On my return I find Frank Finn in 'Indian Sporting Birds' makes no reference to a quail with such a coloured eye, in fact makes little reference to the eye in any of the varieties. I can also say the legs were bright yellow, only the one was flushed and appeared to be mature. For the rest I *think* the throat was white, chest black.

It was in a swamp with tall grass. I hope the colour of the eye will give you a clue?

KURADY KHAN ESTATE,
SANGAMESWARPET P.O.,
CHIKMAGALUR DISTRICT, G. V. R. FREND
(MYSORE STATE)
31st October, 1949.

[The yellow legs and red eye indicate that this was the Blue-breasted Quail (*Excalfactoria chinensis*). It is the size of a Button Quail and distinguished in the hand by its four toes as against three in the latter. Though the Fauna (Vol. V, p. 370) implies that it is widely spread and breeds throughout Peninsular India, there are very few definite records even of its occurrence. Sálim Ali failed to meet with it in his several surveys except at Warangal (Hyderabad) and in Bhopal (Central India). Bidie (*Stray Feathers* IX, p. 208) procured two while snipe-shooting in Chingleput District, while Jerdon 'got it in the Carnatic'. Dewar lists it from Madras without comment, and Ferguson found it in Travancore where he believed it bred. Wenden obtained a stray specimen at Vehar Lake near Bombay (*Stray Feathers* X, p. 165) and also at Poona whence Major W. B. Trevenen (*J.B.N.H.S.* XXVIII, p. 1081) lists it.—EDS.]

8. TWO BIRDS ABOUT WHICH MORE INFORMATION IS NEEDED

PINK-HEADED DUCK *Rhodonessa caryophyllacea*

While in the Manas, Kaziranga and other Game Sanctuary areas in Assam in March, 1949, Mr. Sálim Ali and I kept a sharp look-out for this rare duck and inquired about it from all possible sources. One Forest Ranger made an unconfirmed report of having seen a pair on the Belsiri River in the Balipara Frontier Tract in 1937. This aberrant-looking bird, which seems to me to be transitional between the river and diving ducks, has apparently not been reported by anyone since the mid-thirties. Aside from the unlikelihood of its occurring on a river when it has always been noted as an inhabitant of quiet forest 'Jheels', or 'bhils', I am not at all certain of the above record. I would welcome comment form the members of the Society on the status of this bird, for failing new records I am inclined to list it as extinct in my Handlist, now under preparation.

BLACK KALEEJ. *Lophura leucomelana moffitti*

This pheasant was described by Hachisuka in 1938 from captive birds in the U.S.A. Delacour (*Ibis,* 1949, p. 205) accepts this race and lists its range as 'unknown'. One pair of these birds was shipped from Calcutta to California in 1934, and one or more pairs to Japan in the same year. The male is black all over with steel-blue reflections on the breast and upper parts, a black rump and black lanceolate breast feathers, the latter with faint white shaft lines. The female is like the female of the Black-backed Kaleej, *L. l. melanota,* with a plain buff throat and central tail feathers finely peppered with black, in this character approaching Horsfield's Kaleej *lathami* (=*horsfieldi* auctorum).

The range of *melanota* is Sikkim and western Bhutan, while *lathami* occurs in eastern Bhutan, North-eastern Assam, the Garo and Khasia Hill ranges, the Mikir Hills and on into Burma. It would be very worth while indeed if any information could be furnished to the Society about the occurrence of an all-black male kaleej pheasant. Delacour (l.c.) suggests that the range of *moffitti* might be in central Bhutan, in which case it should be found in northern Assam in the Manas River area and west towards the Sankosh River. While on the Manas Sanctuary this spring (1949), I saw a white-rumped pheasant near a salt lick in the Bhutan foothills. It looked like the usual *lathami,* although I could not see the breast. More information is badly needed to determine the status of the bird known as *moffitti*.

PEABODY MUSEUM OF NATURAL HISTORY, S. DILLON RIPLEY
YALE UNIVERSITY,
NEW HAVEN CONNECTICUT, U.S.A.,
7th February, 1950.

9. POSSIBLE OCCURRENCE OF THE BLACK TERN [*CHLIDONIAS NIGER* (L.)] NEAR DELHI

On October 11, 1949, I was watching a number of terns, mostly Black-bellied, sitting on a sand-bank in the middle of the river Jumna, just north of Old Delhi, and flying round in the air above the sand-bank, when I noticed one bird with a dull grey mantle and square tail, flying round just over the water. It was clearly a marsh tern, and the mantle looked much too dull for a Whiskered Tern. Then I noticed, to my astonishment, that there was a distinct patch of dark feathers on the side of the neck. This I had always believed to be diagnostic of the Black Tern, which as far as I was aware does not occur in India. In England, where I have frequently seen Black Terns in autumn plumage, one regularly looks for that patch, hoping some day to find a bird without it, which would be the rarer species (in England) namely the White-winged Black. And here I was finding the English species in India, where it ought to have been the other way round, and the dark patch should have been lacking.

The bird would not come any nearer, and I had to be content with a view at a distance of perhaps fifty yards. But my companions, Mr. G. L. Cross and Rev. John Bishop, confirmed my impression that the bird had a dark patch on the side of the neck.

Fortunately, six days later, at a point on the river a mile lower down the river, right opposite Old Delhi, I found the same bird (presumably) on sands on the near side of the river, and here I watched it, both resting and in the air, at distances of ten yards and even less, in bright sunlight, the light behind me.

It was an immature bird, with some brownish feathers on the nape and upper back and scapulars. The lower back and rump were whitish, the tail grey, very much the same colour as the wings. The neck patch was grey, not black. This patch was not very conspicuous, apparently being formed by dark tips to only three or four feathers. The beak was black at the base, but it appeared to be rather browner at the tip, possibly due to the bright sunlight causing it to look rather shiny. The eye was black, legs and feet dull reddy-brown. Everything in these details fits the Black Tern best, with the possible exception of the pale lower back, but that was not pure white, as I believe it is in the White-winged Black Tern. In any case, the dark patch on the side of the neck appears to be diagnostic, as there is no evidence that either the White-winged Black or the Whiskered ever shows such a patch.

The Black Tern appears never to have been recorded in India before, but there is a single record from as far east as Tientsin; and since it is a regular migrant in central Asia, the occurrence of a single bird on migration in north-west India is not surprising.

Whilst I am writing about marsh terns, I would like to comment on one thing that puzzles me. Recently I have seen a good many Whiskered Terns, both in Kashmir at their nests in full breeding-plumage, and in winter plumage in various parts of India. The silvery grey colour of the mantle is quite distinct from the dull grey of the other two marsh terns, and I do not understand why this very obvious difference has not been noted as the most obvious and ready means to identification.

24 Rajpur Road, H. G. ALEXANDER
Delhi,
8th February, 1950.

10. STATUS OF THE RED-CRESTED POCHARD (*NETTA RUFINA* PALLAS) IN SOUTH INDIA

It might interest you to know that yesterday whilst shooting on the Godavari River near Rajahmundry there was a flight of approximately 50 of these ducks. We shot five male birds and one female. The condition of the plumage was very good and the ducks were easily identifiable from the illustration in Stuart Baker's 'Ducks'. Three days earlier I also saw four male birds on the Godavari River and was able to approach them closely and easily identify them.

It might also interest you to know that I have shot this species in Chirala and Ongole in the Guntur District in 1947.

P.O. Box No. 20,
Rajahmundry, M. & S.M. Rly., A. J. BROCK
East Godavari District.

[Subsequent to the above Mr. Brock wrote in advising that he had seen more flights on the Godavari around Rajahmundry and also between Polavaram and Bhadrachellam. He believes that they are commoner this season than ever before. In a recent issue of the *Journal* (Vol. XLVII, p. 750) we have referred to other records from Madras Province, and while numbers may vary in different years, this species is certainly much commoner than has been recognised. —EDS.]

11. OCCURRENCE OF THE SCAUP DUCK [*AYTHYA MARILA* (L.)] IN THE BOMBAY DECCAN

On 6th February 1949, a party of seven guns from Ahmednagar visited a jheel some 19 miles away, known as White Temple Lake, from a small white painted temple on the top of a hill overlooking the lake. It is a medium sized attractive lake formed by an obviously ancient artificial bund of great thickness.

At the end of the shoot we collected to count the bag, and Major S. D. Gupta, R.I.A. produced among his birds what looked like a pochard but was unlike any of the pochards we knew. I therefore sent the skin of this bird to the Bombay Natural History Society who pronounced it to be a Scaup, an uncommon bird, and very rarely found so far south as this. Indeed the last one recorded was at Panvel, near Bombay in 1884.

Unfortunately, none of us, ignorant of the prize we had secured, can say whether this was a solitary specimen.

Our bag that day was unusually varied, for besides the scaup, it included pintail, gadwall, wigeon, red-crested pochard, common or red-headed pochard, white-eyed pochard, teal, shoveller and snipe. Among so many, the absence of the tufted pochard on that day is notable.

I.A.C. CENTRE & SCHOOL, W B. ASPINALL
AHMEDNAGAR, *Brigadier*
10th November, 1949.

[The females of the Tufted Pochard and the Common Pochard occasionally also show some white round the face (normally much less than in the Scaup), and it may thus be helpful to record the other differences. The Common Pochard has *no* white wing-bar though vermiculations on the back are present as in the Scaup. Both the Scaup and the Tufted Pochard have white wing-bars.

The wing of the Tufted Pochard ranges between 189 and 208 mm. while in the Scaup it measures 210-230 mm. The bill of the Tufted Pochard is shorter and narrower. According to Witherby (Handbook of British Birds) it measures 38-42 mm. as against 41-47 mm. in the Scaup.

In the Tufted Pochard there are no vermiculations on the back. The back, moreover, is less dark than in the Scaup. Of course these differences need to be looked for only when the crest is not visible. —EDS.]

12. THE OCCURRENCE OF THE WOOD SNIPE (*GALLINAGO NEMORICOLA* HODGS.) NEAR POONA

The Wood Snipe which I handed over to you the other day was secured in a nullah about a mile from the village of Mahalunge near Chakan on the Poona-Nasik road in a region of low scrub-covered hills. The bird got up in a patch of swamp densely covered with tussocks of waist-high grass where a few snipe were also put up. It was very distinct from the other snipe on account of its size and comparatively very slow flight. This was on the 15th January 1950.

116, Koregaon Park,
Poona, M. SUTER
30th January, 1950.

[The barring on the underparts extending to the abdomen together with its general duskiness gives the bird a 'woodcocky' appearance but from which bird it is differentiated by the longitudinal stripe on the head as compared with the transverse bars in the woodcock. In addition to this the attenuated outer tail feathers, the buff borders to the scapulars and the appreciably larger size separate this species from all other Indian snipe. The Fauna (Vol. VI, p. 255) gives the wing as ranging from 133-141 mm. but in the above specimen it measured 152 mm. while we have others in the Society's collection measuring 148 and 150 mm.

The Wood Snipe has been obtained near Thana by Major M. L. Ferrar, near Bombay by T. H. Moore and at Ambarnath (Kalyan Taluka, Thana District) by H. M. Molesworth, all records being for January. In winter it has also occurred in Central India and in the hills of Coorg, Wynaad, Nilgiris, Annamalais, Shevaroys, etc.—Eds.]

13. FIELD IDENTIFICATION OF BIRDS

As one who has watched birds for fifty years, and does not shoot, I was glad to see the note in the *Journal* (Vol. 48, p. 587) by the editors warning against faulty identification. What I miss in the editors' note however, is any practical suggestion for ensuring correct identification. May I attempt to fill at least part of this gap?

(1) I would suggest that when a record of a rare species is submitted, full particulars should always be given of the conditions under which the observation has been made. Thus, how long was the bird under observation? Was it seen only at rest or only in flight or both? At what approximate distance was it seen? Was it seen above the observer or below? Was it seen through binoculars (if so, of what magnification?) or only with the naked eye? What were the conditions of the light? Was the sun shining, and if so was it behind the observer or behind the bird, or where?

(2) If possible, comparison with some commoner species should be made, both as to colour and size and shape.

(3) In describing colours, it is almost useless to say, 'Black on the head', or 'Pale on the wing', or any other vague statement of that kind. Which part of the head or the wing? Almost every good text-book of birds has a chart showing how to name the different parts of the plumage, e.g. crown, nape, scapulars, wing-coverts, primaries, chin, throat, breast, etc. and it is often of vital importance in making an identification sure to know exactly where the striking colour (whether black, white, red, blue, etc.) really was. Whenever possible a full description of the bird seen should be written down on the spot, not *after* you have begun to look it up in the book. It is terribly easy to imagine afterwards that you saw something which in fact you did not see. The whole description should be written down, for sometimes the identification may rest on some rather trivial detail, e.g. the extent of a pale eye-stripe over the eye. Did it extend almost to the nape or did it end just behind the eye?

Special points of shape should be noted, e.g. long tail, stout beak, crest, etc. In some sea-birds, such a point as whether the wings extend beyond the tail when the bird is at rest, or whether the tail is slightly forked, rounded or square at the end, are important.

(4) Size and shape are very deceptive points. It is dangerous to jump to conclusions. It is really amazing how different the size of a bird may appear to be under different circumstances. Unless you have actually seen two birds of different species in company with each other, it is unwise to say dogmatically that the bird you are describing was smaller or larger than the other, commoner one. Moreover, in flight, the shape of the wing may vary according to the position of the bird and the conditions of wind etc. Anyone who has watched kites in the air will know that sometimes they fly in such a way that for a time the observer, even after long experience, may feel almost sure that he has quite another species under observation. Again, one sometimes sees a number of large birds soaring in the sky, and then you perhaps notice a bird that looks a good deal smaller. But in the end you realise that its apparent smallness is simply due to the fact that it is much higher in the air.

(5) Song and call-notes can be a very valuable piece of supporting evidence of identification. Again, it is most necessary to record the sound, as exactly as possible, at the time. It is extremely difficult to recall the exact phrase of a bird's call-note accurately after an interval of an hour or two.

I would add that, especially with small birds, pipits, warblers and the like, much patience is needed, and a capacity to stand quite still for a long time. And it is well, whenever possible, to go a second time, and try to see the unknown bird, or the suspected rarity, again, in the light of the possibilities suggested by the books of reference.

Finally, I hope field observers will recognise that, as a rule, subspecies cannot be identified in the field, and it is better not to pretend that you have gone further than identification of the species.

24, RAJPUR ROAD,
DELHI,
6th February, 1950.

H. G. ALEXANDER

14. FREAK SHOTS

I always find it interesting to read anything under the above heading and therefore I was glad to see Mr. MacDonald's letter in Vol. 48, No. 3. If you are not already flooded out with similar letters I would like to add one or two experiences of mine, in case you are interested.

Shooting 'into the brown'. I remember snipe shooting one early morning 17 or 18 years ago with a friend at the Salt Lakes near Calcutta when a large wisp of snipe, numbering about 60, flashed past me just off ground level at such a pace that I completely failed to get off a shot. As however they were heading for my friend (who was looking the other way) I bellowed at him and was most amused to see him swivel round and discharge both barrels almost simultaneously into the pack. The resultant pick-up was 11 or 14, I can't remember which.

This however was not as remarkable as the effort of a game keeper which I witnessed in Ireland in County Wicklow when I was a boy. This man was absolutely first-class at calling down Golden Plover, which he did with the aid of a penny whistle. We lay side by side in a depression in the middle of a large sheep pasture one cold November morning and Campbell was soon successful in calling down a very large flock of, I should think, a couple of thousand Golden Plover. They settled very thickly all around us and Campbell whispered to me to watch him 'shooting for the pot', as he described it. He gave them the first barrel on the floor, which did not seem to do much damage but his left barrel into the flock as they wheeled away had the most devasting effect. We picked up no less than 57 and I will never forget how horrified and amazed I was.

Mixed bags. The following rights and lefts that I have myself had may be of interesting:—

(*a*) A hare and a wood pigeon while shooting a bog in County Wicklow in 1926.

(*b*) Two tiger in a beat in a block in Mandla Division in the C.P. in January, 1943. The animal shot with the left slithered forward on its belly, quite dead, right under my machan, so great was the impetus of its charge.

(*c*) A peacock and a bear in a miscellaneous beat in Bastar State in 1933. In this case peafowl were pouring down the hill when I heard a bear vociferating close ahead of me. I just had time to slip a Contractile into my right barrel when the bear charged out and I rolled him over at close range. Simultaneously I noted a lovely peacock flying straight at me. He naturally got the left barrel.

Fluke shots. Flighting sandgrouse one morning near Ahmednagar in March 1941 I had a strange shot. I was hidden in an oleander bush and saw four sandgrouse about to pass me fairly close. I fired at the leading bird, which dropped, and then found to my astonishment that there was nothing to use my second barrel on, as the remaining three birds had disappeared. I simply could not make it out until I collected all four stone-dead close together. By some strange coincidence of flight all four must have got dead in line at the critical moment of the first shot.

I also well remember the, I should think almost unique, coincidence of seeing three snipe killed by one barrel on no less than three occasions in one day. This was whilst shooting a bog in the County Wicklow many years ago. I did it twice within half an hour in the morning and a friend repeated it once in the afternoon. On the first occasion I was not aware that more than one bird had got up. That was a close one and I dropped it at about 15 yards range. The other two were in a straight line at about 35 yards and 60 yards respectively. In each case they were marked by my Red Setter or I would not have known of their existence. The other two were cases of birds getting up in a bunch together and of lines of flight coinciding at moment of firing.

Strange experiences. The following two stories may be of interest, the first of which was actually witnessed by me and the second I can vouch for as it happened to a friend, now retired from India, who was not given to telling tall stories.

A party of us were shooting grouse in Scotland in 1936 and the grouse were few and far between. It was early September and we were walking in line over some rough ground when an old cock grouse got up and charged off low over the heather. A fusillade of shots followed him but he got away unscathed and we watched him more or less out of sight. Two hundred yards ahead however there was a noise of impact like the crack of a rifle and the bird disappeared. We all heard this extraordinary noise and moved forward rapidly to investigate. We found that a woodcock had happened to jump up out of a patch of bracken directly in the grouse's path. The grouse's head was driven right into the woodcock's breast. The woodcock was stone-dead but the grouse's heart was still feebly fluttering when we arrived on the scene. I think I am right in saying that this incident was reported by my host to the *Field*.

The other incident concerns a kaleej pheasant. My friend was shooting some years ago in the Naini Tal District and he had been warned that there was a panther about so that he was carrying a few Lethal. A kaleej got up and flew straight down the path and was duly bowled over. The bird fell on the path but seemed to jerk itself off the path and over the khud. My friend and his shikari charged up and the shikari was lucky enough to recover the bird many yards down the khud-side. When he came back it was found that the bird's head had been completely removed, which seemed extraordinary as the shot had been fired at about 40 yards range. The explanation was found to be that my friend had had a Lethal in his right barrel and, in his excitement, had forgotten this and pressed the wrong trigger. There was no mistake about it as he checked up on the cartridge cases, which were of different colours. Do not blame me if nobody believes this story but, as I said before, my friend is a very honourable man!

c/o BALMER LAWRIE & CO., LTD.,
21, NETAJI SUBHAS ROAD,
CALCUTTA,
25th January, 1950.

P. H. SYKES

15. OCCURRENCE OF RUSSELL'S VIPER [*VIPERA RUSSELLI* (SHAW)] IN KATHIAWAR (SAURASHTRA)

As K. S. Dharmakumarsinhji desires to know (*J.B.N.H.S.* Vol. 48, p. 595) of an authentic record of Russell's Viper in Kathiawar I may inform him that it occurs in the Sorath Region of Kathiawar.

I first came across a single individual some ten years ago in a valley of the Datar range of hills. It was disturbed at a sun bath and disappeared into the thickets.

In my college museum there are 3 specimens of this viper all collected in the college compound. Two of these are preserved in spirit while the third is a skin cured by myself and mounted on khaddar cloth. This is 3 ft. 6 ins. in length.

The snake mentioned by Mr. Vasu in Vol. 48, No. 1 page 190 of the *Journal* is too small for a full grown Russell's Viper and may be, as suggested by K. S. Dharmakumarsinhji, probably a Saw-scaled Viper *Echis carinata*.

BAHAUDDIN COLLEGE,
JUNAGADH (SAURASHTRA). G. A. KAPADIA
1st December, 1949.

16. THE RECORD BLACK EARTH BOA [*ERYX JOHNI* (RUSSELL)]

The following measurements and lepidosis of a female Black Earth Boa (*Eryx johni* Russell) seem worth recording. The snake was acquired in August 1949 from a snake-charmer who said it had been caught off Thana near Bombay.

Total length	4′ 2″
Tail	3″
***Lepidosis*:**	
Costals	
(*a*) Two head-lengths behind the head...	62
(*b*) Mid-body ...	65
(*c*) Two head-lengths before the vent ...	49
Ventrals ...	213
Caudals ...	34

The specimen weighed 2½ lbs. on the day it was brought in.

Boulenger and Smith in their Fauna of British India volumes on Snakes both record a specimen measuring 3 ft. 3 ins. Major Wall in his Handlist of Snakes of the Indian Empire, and Prater (Snakes of Bombay Island and Salsette, (*J.B.N.H.S.*, Vol. 29, p. 353 and Vol. 30, p. 21 respectively) write of one 3 ft. 7½ ins. long. Ditmars (The Snakes of the World, 1935) states that the Black Earth Boa grows to about a yard in length while Col. Gharpurey (Snakes of India, 1935) mentions its reaching 4 ft.

114, APOLLO STREET,
BOMBAY, V. K. CHARI
8th December, 1949. *Asst. Curator*

17. EFFECT OF ATMOSPHERIC PRESSURE WHILE FISHING

(*With a photo*)

I was recently able to put my small pocket aneroid barometer to further use while fishing. During the first five days of my fishing trip to the Manas river last November the barometer was fairly high and remained steady, and the fish were on the take all the time.

The black mahseer on the left (9½ lb.) was the only fish moving from 11 a.m. to 1-30 p.m. The four fish (including another 7 lb. black mahseer) were caught in the evening when the glass was rising.

On the sixth day, however, I fished a good long pool from 11 a.m. till 1.30 p.m. without a bite (except for an incident which I will describe later). I had fished this same pool at the same time, with the same spoon, on a previous day, and killed 8 fish. But on this day not a bite. I therefore consulted my barometer and found that the glass had fallen and was still falling. Scanning the horizon, I espied a few suspicious clouds beginning to put in an appearance. I fished a short time after this and then gave it up and did some photography at a place where I had wanted to go but had previously been too engrossed with fishing.

At 4 p.m. the glass stopped falling, and started to rise slightly. I took up fishing again, and between 4.15 and 5 p.m. had the best sport of the week—killing four fish, and losing one, in the short space of three-quarters of an hour. The fish had really come on the feed.

Now for the 'incident' referred to above. In the mid-day fishing period, when nothing was moving at all, one darkish fish was jumping out of the water in sheer joy, so it seemed, and was seen to do so four or five times. I caught it, and it had taken the spoon right down its throat, good and proper. It turned out to be a black mahseer of 9½ lb. And it so happens that one of the fish caught that same evening was also a black mahseer of 7 lb. (no bokar were caught on that day). It is possible, therefore that black mahseer (a fairly rare fish in Assam) come on the feed, or at any rate are caught, on days of low or changeable atmospheric pressure. In support of this I remember a day on another river some years ago (the Koliani in March 1947) when the sky became overcast and a few drops of rain fell. Not a fish moved anywhere from 2 p.m. onwards—except at 4 p.m. when my companion caught a black mahseer of 4 lb., and a bokar of 2 lb.

It would be interesting to hear if other anglers have any experiences to prove or disprove the theory of the effect of atmospheric pressure on fishing in general, and on black mahseer in particular.

DOYANG T.E.,
OATING P.O., E. P. GEE
ASSAM,
15th December, 1949.

18. WHALE SHARKS IN INDIAN WATERS

To the records of Whale Sharks from the west coast of India cited by Prater (Volume 42, page 256) and by C. V. Kulkarni (Volume 47, page 762) may be added the recent capture of another leviathan of the shark tribe from around Baba Islands off the coast of Karachi early in November 1949 reported by Mr. Irfan Hussain in the *Illustrated Weekly of India* for 27th November 1949. The specimen, a photograph of which was also published, is said to have been 38 feet in length, 23 feet in girth and 4 tons in weight.

Whale Sharks are the largest of all living fishes but have none of the rapacity associated with true sharks. They are usually met with floating on the surface of the sea and are so sluggish that they let themselves be easily approached and harpooned. Even after being wounded they seem to evince the greatest indifference to their fate as is shown from the following account by Frank W. Lane in an article entitled 'Scavengers of the Sea' published in the *Field* of 24th October 1949 and reproduced here with acknowledgment.

"The Whale Shark is the largest fish in the world. According to Dr. E. W. Gudger, who has made a special study of this fish, a whale shark 55 feet long has been known, and another specimen filled the 60-foot long fish-trap in which it was caught. Capt. Young writes of an estimated maximum length of 70 feet for these sharks and mentions a specimen landed at Miami which weighed 13½ tons and which broke the tackle as it was being hauled out on the marine railway.

Although the whale shark is so huge it is one of the most inoffensive and sluggish creatures in the sea. It is a plankton feeder, using its sieve-like gill-rakers to strain small crustaceans and similar fare from the water. Its mouth is equipped with some 6000 teeth, only $\frac{1}{8}$ of an inch long.

The body of a whale shark is covered with a rubbery gristle which is 4 in. thick in a full-grown shark. A remarkable feature of this 'armour plating' is that the shark appears to be able to strengthen it at will by tightening its dermal muscles. Dr. W. Beebe writes that on one of his expeditions a whale shark was encountered and a harpoon driven into it. But despite the utmost efforts to drive further harpoons in they 'bent as if they had struck steel',

I have read another account in which a whale shark was fired at between 40 and 50 times without visible effect, and when a shotgun loaded with No 2 shot was fired at the shark from a distance of about 2 feet the shots 'just bounced, leaving a little circular mark in his skin'. Incidentally, Mr. Gilbert Whitley, of the Australian Museum, has recorded that the hide of a large sun-fish, which is similarly thick and leathery, has proved impervious to the bullets from a Winchester rifle!

There can surely be few creatures which have a greater apparent indifference to their fate than the whale shark. Even when harpooned, lassooed round the tail and drawn along by a motor-launch, fired at and made to suffer other indignities, these leviathans seldom make any desperate effort to save themselves.

In one case reported by Capt. Charles Thompson a whale shark, after undergoing the attentions mentioned above, did not seem 'to realise that anything in particular was happening to him, but kept circling around, moving his great tail, in a slow regular way, drawing the small boats after him with the greatest ease'. At last the shark was headed, by poking it with a boat-hook, towards a sandbank and there made fast. The shark was eventually killed by having a piece cut from the top of its head and its brain prodded with a knife stuck on the end of a pole.

Another instance of the extreme indifference to man of the whale shark was shown during the taking of a film of one of these sharks. During one sequence the director stepped on to the back of the 'star', stayed there for some five or six seconds, and then only climbed back into the boat for fear he might be taken for a ride!

This amazing indifference to its fate is undoubtedly largely responsible for the various encounters which have occurred between whale sharks and ships. The whale shark is unmolested by anything which swims and there is nothing in its ancestral memory to make it fear its huge fellow travellers in the seas. Therefore it goes placidly about its business of feeding and apparently it never occurs to its dim brain that the huge iron-clad monster bearing down upon it will not swerve aside and may strike it with deadly force.

Of the many accounts which could be given of such ship vs. shark encounters, I have selected that by Capt. Klebingat of the schooner-yacht 'Navigator'. The Capt. writes:—

'The vessel was struck on the starboard side by an immense shark. The wheel was wrenched out of the hands of the steersman. The tail of the fish rose 8 feet above the water-line. The engine stopped as the fish struck the propeller. The shark, distinctly seen when it went astern, was of a mottled colour, and at least 30 to 35 feet long. After going into drydock, it was found that considerable damage had been done to the hull and rudder of the ship.''

114, APOLLO STREET, FORT,
BOMBAY, EDITORS
5th December, 1949.

19. SPECIFIC NAMES OF THE TWO COMMON INDIAN *COLIAS* BUTTERFLIES

I notice that Mr. Wynter-Blyth in his article of An Expedition to Sangla in Kunawar [*J.B.N.H.S.* (1948): 373] refers to the 'Dark Clouded Yellow' as *C. croceus* and to the 'pale' as *C. tyale*. It is now generally considered that the two common Indian species previously known under these names are not conspecific with these Western European species and that the correct name for the common orange species is *Colias electo* L., *fieldii* Men., and for the yellow *Colias erate* Esp., *erate*. Talbot, in the Fauna of British India, Butterflies, Vol. I (2nd ed.) uses these names, but I am still separated from my library and so cannot give references.

KAMPALA, D. G. SEVASTOPULO,
10th January, 1949. F.R.E.S.

20. A HONEY-BEE IN THE NEST OF A MASON-WASP

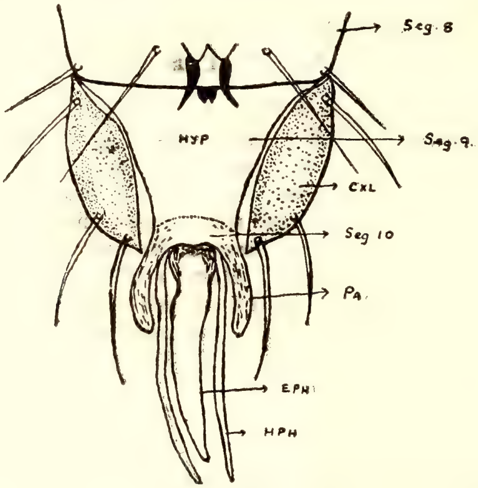
With reference to Capt. Boswell's note under this heading [*J.B.N.H.S.* 47 (1948): 771] and to Lt.-Col. Hingston's comment, there is also the possibility that the so-called Honey-bee was really one of the solitary Mason-bees. Many of these build clay nests very similar to those built by the Mason-wasps, except that they are provisioned with a mixture of honey and pollen instead of with paralysed insects or spiders. It seems very much more probable that a solitary bee had built its nest unobserved in the rolled up tent and that the resulting imago was on the point of emergence when the cell was broken into, rather than that a honey bee had either crawled into, or been packed in, the cell of a solitary wasp.

KAMPALA, D. G. SEVASTOPULO,
10th January, 1949. F.R.E.S.

21. THE MALE GENITAL ARMATURE OF *AYYARIA CHAETOPHORA* KARNY

(*With a text figure*)

The male genital armature of some of the Thysanoptera have been described in detail by De Gryse and Treherne (*Canadian Entomologist*, 1924). But *Ayyaria chaetophora*, a member of the subfamily Thripinae, exhibits some differences with regard to the shape and the structure of the relative parts concerned. The coxal lobes which are heavily chitinised, bear anteriorly one pair and posteriorly two pairs of long setae and are easily distinguished from the subgenital plate or hypandrium. The coxites seem to be absent. The periandrium with its arching sides (endapophyses), is well developed and between them carry the epiphallus and the hypophallus. The epiphallus is wider anteriorly, gradually narrowing towards the posterior extremity and the hypophallus is almost uniformly slender.



Male genital armature of *Ayyaria chaetophora* Karny
Hyp—hypandrium
CxL—coxal lobe
PA—periandrium
Eph—epiphallus
HpH—hypophallus.

T. N. ANANTHAKRISHNAN, B.SC. (HONS.),
LOYOLA COLLEGE, MADRAS, *Lecturer in Zoology.*
5th November, 1949.

22. OBSERVATIONS ON THE OCCURRENCE OF THE TICK *APONOMMA GERVAISI* (LUCAS) ON *VARANUS* SP.

The genus *Aponomma* is represented in India by four species viz:—*A. gervaisi* (Lucas) including var. *lucasi* Warb., *A. laeve* Neum., *A. pattoni* Neum., and *A. trimaculatum* (Lucas). From Orissa only the species *A. gervaisi* and the variety *lucasi* have been recorded. The species *A. gervaisi* is known only from the Barakuda Island of the Chilka Lake on *Varanus bengalensis,* both males and females having been collected on the host[1].

On the 9th July, 1945 a 'Godhi' (Oriya)—*Varanus* sp. measuring 3 feet $7\frac{1}{2}$ inches from the tip of the head to the tip of the tail was killed in the city of Cuttack. On examination I found that immediately posterior to the anal aperture there was a cluster of silvery shining ticks. A total number of 32 females of *A. gervaisi* was collected in this cluster and no male specimen was obtained.

---

[1] Sharif, M. (1928): A revision of the Indian Ixididae. *Rec. Ind., Mus. Cal.* 30: 333-341.

Sixteen specimens were measured of material preserved in formalin. The body length excluding the rostrum which is usually bent almost at right angles to the body as is usually the case in members belonging to Acari, varied from 2.2 to 2.7 mm. with an average of 2.3 mm. in length and from 2.2 to 3.0 mm. with an average of 2.6 mm. in breadth. Thus the breadth was definitely longer than the length.

The infection of ticks immediately posterior to the anal aperture may be due to the softer nature of the area.

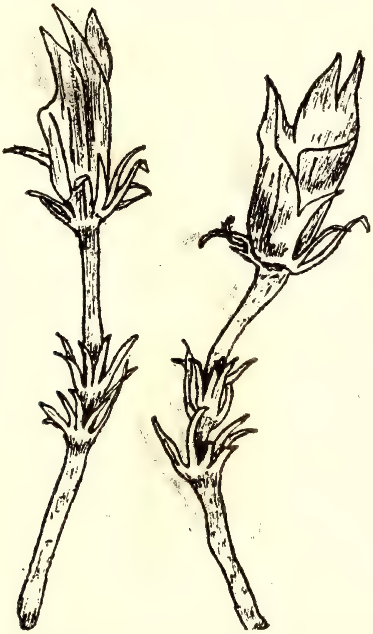
My thanks are due to Mr. E. Browning of the British Museum (Natural History) for the identification of the ticks.

London, BASANT KUMAR BEHURA
23rd January, 1950.

23. REDUPLICATION IN THE EPICALYX OF *HIBISCUS* L.

(*With a text figure*)

Malvaceae is a Natural Order where the flowers often possess an epicalyx. *Hibiscus rosa-sinensis* L., (N. O. Malvaceae) is a species much cultivated and the flowers possess an epicalyx of a single whorl of free bracteoles at the base of the calyx tube commonly consisting of 6-7 bracteoles.



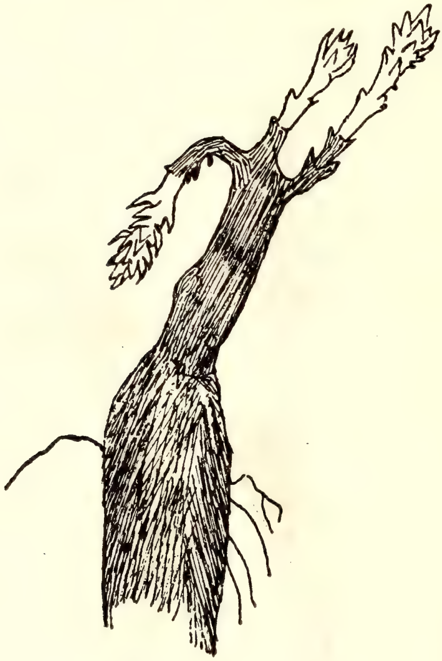
Two views of same *Velox* flower showing calyx and epicalyx only.

It is interesting to note that in a few specimens brought for class-work, and examined casually, the epicalyx is in three series of free bracteoles. The bracteoles in the first series just at the base of the calyx tube, where normally the epicalyx occurs, are 13 in number disposed more spirally. The second and third series arise on the pedicel disposed in whorls consisting of 8 and 9 respectively. This feature of the epicalyx, though it seeems to be an horticultural freak, common in cultivated plants, may be in the direction of securing additional protection to the flower bud.

Department of Natural Science, J. L. KANTARAO
Hindu College, Masulipatam, V. VENKATESWARLU
6th December, 1949.

24. A NOTE ON THE GROWTH IN A HERBARIUM SPECIMEN OF *PORTULACA TUBEROSA* ROXB.

(*With a text figure*)



Portulaca tuberosa Roxb. (Portulacaceae) is a common herbaceous weed with tuberous roots in sandy situations near the sea[1]. In

---

[1] Maypranathan, P. V. (1933): Bulletin of the Madras Government Museum: Natural History Section, Vol. 2., P. 33 (*Government Press, Madras.*)

September 1948, while changing pressed plants collected at Pichavaram (a sea shore village) after fifteen days, certain fresh tiny buds were found to be growing adventitiously on the dry terminal distal ends of the herbarium specimen of *Portulaca tuberosa* Roxb. The production of buds on dry specimens specially under abnormal conditions of the plant-press aroused some interest, and a close observation was therefore made on the very same specimen under similar conditions for over 10 months. As a result it was found that the buds continued to grow slowly under the drying sheets. The three buds which continue to grow even now, measure 14 mm., 14 mm., and 8 mm. The leaves are reddish in colour and the tuberous root has been pressed flat by the pressure of the plant-press.

This peculiar behaviour of *P. tuberosa* Roxb. is very interesting and it demonstrates the enormous power of endurance of the plant under the most unfavourable conditions of the pressure of the plant-press, and lack of light and water. A similar phenomenon was observed by Singh[1] in 1933 in herbarium material of *Coleus barbaratus* Benth. from the North-western Himalayas.

I am much grateful to Professor T. C. N. Singh for his kind suggestions and criticisms during the course of the preparation of this note.

BOTANY LABORATORY, A. T. NATARAJAN
ANNAMALAI UNIVERSITY, ANNAMALAINAGAR,
25th July, 1949.

[A few years ago, one of us (H. S.) collected a specimen of *Euphorbia khandalensis* Blatt. in Khandala, on the Western Ghats; the tuber measured 35 cm. long 6 cm. diam.; after removal of leaves, etc., the tuber was left to dry in the sun for several months, and was then placed in a cupboard, where formaline fumes were very strong. After six months in such a cupboard, the specimen burst into flower, after which fruits were produced in normal numbers. After being in this formaline atmosphere for over a year, the tuber was removed and planted in a flower pot; the plant has been producing flowers, fruits and leaves for the last eight years in succession. In the case of epithytic orchids, it is a common experience in Bombay to find them growing even after they have been dried, pressed and attached to the herbarium sheets. But perhaps one of the most remarkable cases that has come to our notice was one of *Euphorbia* (*neriifolia*?) noted by Mr. C. McCann, formerly Joint-Curator of our Society; for over a year Mr. McCann kept a branch of *Euphorbia* on a shelf in the Society's office; the plant was not watered nor even planted in soil, it was merely left on the dry shelves to wither and die. To speed up the death of the plant, Mr. McCann plunged the lower part of the plant into *boiling* water; in a day or two after such an immersion, the plant burst into flower. In view of such experiences, it is a good practice to have all plants properly poisoned with Mercuric Chloride in alcohol before entering them into the collection of a herbarium.—Eds.]

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[1] Singh, T. C. N. (1933): A unusual growth phenomenon in *Coleus barbaratus* Benth. *Current Science,* Vol. 1., p. 273.

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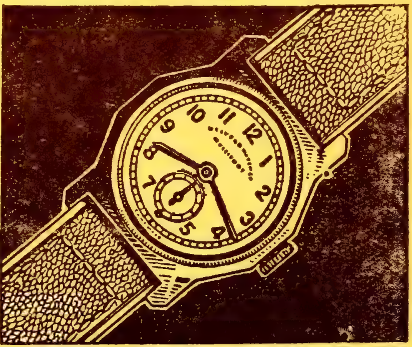

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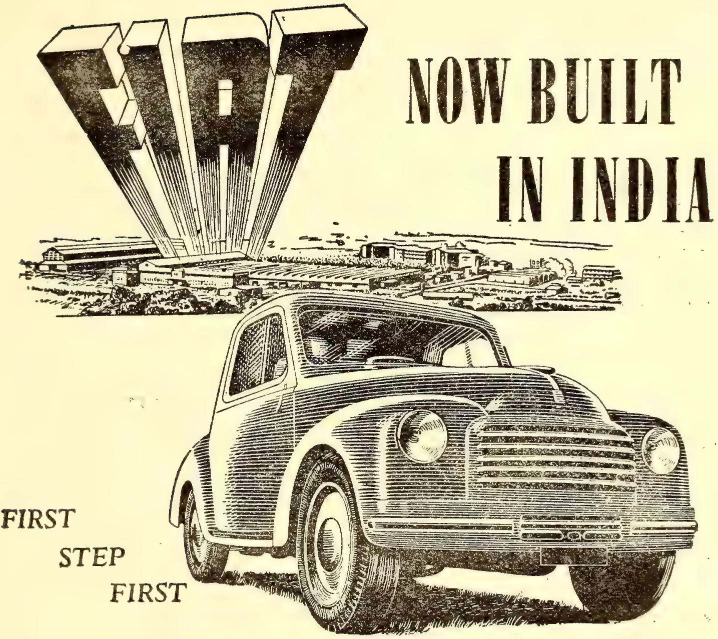

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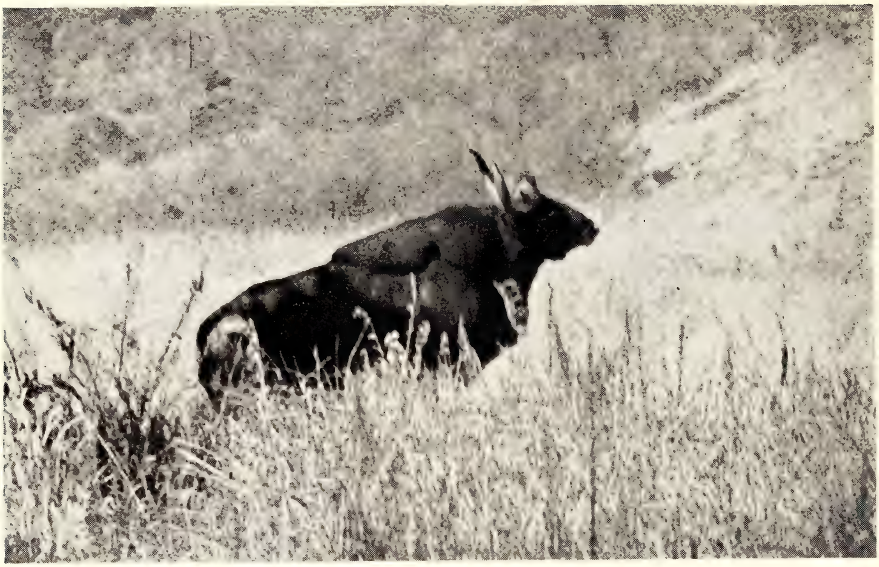

A solitary bull Gaur.

Photos *Sálim Ali.*

A herd of bison in tall grass.

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JUNGLE MEMORIES

BY

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PART VI—BISON, TSINE, ETC.

(*With plates*)

BISON

It is, I suppose, the ambition of every budding sportsman to bag a bison. It certainly was mine from my earliest days in India, but many were the fruitless tramps I had after this grand animal before I got a shot. My first efforts were in Chanda in 1906, where rinderpest had unfortunately cleared the best areas, but H. and I managed to secure a block free of disease. The season (August) was a good one for tracking, but bison were so few and far between that, as I now realise, we were simply wasting our time trying to find a shootable bull. In March of the following year I was again in the Chanda jungles, and spent some time looking for an old solitary which was reported to be very aggressive, and which the D.F.O. told me had a short time before killed a buffalo calf tied up for tiger, but I was unable to contact him. If there was any foundation for the story of his bad temper, then I feel sure that he must have been wounded, for my experience is that bison normally are timid animals, and will not attack without cause. However these trips, though unsuccessful as regards the main objective, afforded other game, and above all gave me that experience of the habits of bison and of the details of tracking which were to prove so useful in years to come.

The first bison I shot was in North Canara, where I found them far more numerous and much less difficult to contact than in the C.P. Moreover the monsoon had broken, so tracking was easy. I reached my camp at Pardhana on the 8th June 1909, and found Raya Gouda waiting for me; he proved to be one of the best shikaries I have ever met. Next morning we started off at dawn for a favourite locality, but on arrival found the whole place a litter of confusion, with branches lying about and bamboos broken down and smashed by a herd of elephants. The shikari thought this would have scared everything else away, so we moved further on. My experience of bison in the Central Provinces was that they lie down to chew the cud between 9 a.m. and 3 p.m., but Raya Gouda assured me that during the monsoon we should find them still feeding up to midday, and subsequent events proved him correct.

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About 10 a.m. we came across very fresh tracks among wild melon shoots, and shortly after saw a big bull looking at us about 100 yards away. I aimed for his chest, but he turned and bolted before I could fire, so I had to take a running shot which missed, as the bullet glanced off a fallen tree just after the bull had jumped it. Half a mile on the tracks led us to a herd of some 20 animals which were feeding away from us. We worked round and got ahead of them as they slowly crossed an open glade. I had never seen bison in the herd before, and though they were in full view, could not make out which was the bull. To me they all looked the same, so I signed to the shikari that I did not know which to take. He held up five fingers, by which I understood him to mean that the fifth was the bull. It certainly was a very black beast, and as they would soon be gone and the chance lost, I fired at its shoulder. The herd bolted and there was no blood, but I was certain that I had hit, though the shikari was sceptical. After following the line for a short distance, I saw the wounded one staring at me from the bottom of a nullah some 50 yards away. Only the head was visible, so I moved up closer for a knock-out shot, but the animal bolted before I could fire. Rain then came down in such torrents that we had to take shelter for half an hour, but as soon as it cleared we again took up the almost obliterated tracks. The shikari managed to puzzle them out very slowly, and after about half a mile I saw the bison standing very sick and broadside on some 100 yards away. I took a standing shot at the shoulder, and though the beast moved on, was confident that I hit about about the right place. After a short distance we found it lying down and apparently dead, but it tried to rise as we approached, and I finished it off with a shot through the brain.

I wish I could record that it was a very fine head, but these jungle memories are, as their name implies, a narrative of fact and not of fancy, so leave it to my readers to imagine my dismay when I found that I had shot a cow! And what made it far worse was that another sportsman had committed the same offence only a short time before in the same jungle, and the D.F.O. had therefore asked me to be particularly careful not to make a similar mistake. The shikari also was very upset, and asked me why I had fired at all when he held up his hand to warn me to wait, as the bull was not in sight. Unfortunately I had mistaken his signal, but that was poor consolation.

Others too have made a similar mistake over their first bison, though it is not all who would admit it, and frankly, after 40 years further experience, I am inclined to think that the shooting of an occasional cow is rather a good thing. Comparatively few fall victims to tigers, and so there is no check on their increase till Nature steps in and wipes out whole herds with disease. However that may be, not one sportsman in a hundred will deliberately fire at a cow, so let us analyse the mistakes I made on this occasion.

First, colour is no guide—one will find old cows as black as any bull. How then to distinguish the latter? A shootable bull, apart from actual horn measurement, is conspicuously larger than any cow and is quite unmistakable if seen in company with them. If you come across a herd and they seem to be all much of a size, you may be quite sure that no shootable animal is present. In that case do not be in too much of a hurry, but sit down and wait, and sooner or later the herd bull will appear, when you can decide whether he is shootable or not. Some books will tell you that a herd bull never carries a good head, and that one should restrict oneself to solitaries, but in my experience it always pays to examine a herd, in case it has been joined temporarily by a solitary bull. In some parts of the country the shooting licence prescribes definite limits of size for a shootable head. For instance, in the Nilgiris it is 33 inch spread, or 18 inches in girth, the spread being the horizontal distance between the outer edges of the horns at their widest. How is one to judge whether a bull is up to this standard? Even with years of experience it is extremely difficult to estimate girth, but if one remembers that from tip to tip of a bison's ears when extended is about 33 inches, one has a rough guide as to spread. If the horns project beyond the ear-tips, you should be safe in firing.

What other mistake did I make? I was using solid bullets whies certainly was correct, as they are necessary for penetration through bone, but what I did not realise is that a bison's heart (like an elephant's) is situated lower than in the case of other animals, and roughly speaking is only about one-third of the way up from the bottom line of the body instead of half-way, so my shots were a bit too high.

To resume—I had one more chance at a bull in the same jungles, but messed it up. After the regrettable incident of the cow, I decided to stick to solitaries, but it was eight days before we came across one. We had started at dawn, but it was not till 3 p.m. after many hours of tracking, that we saw a big bull in the bushes only 60 yards away, coming diagonally towards us browsing—only his back was visible. Raya Gouda had impressed on me the importance of taking the first good shot which offered, so as the bull's head came out of the bushes, I fired at his ear-hole at about 40 yards. I had hoped to brain him on the spot, but was not too steady, and the bullet must have grazed the back of his head, for he rushed off and we could find only a few drops of blood. We followed some way, but though he stood more than once I was unable to get another shot in the thick cover, and finally we had to give it up. The wound was obviously little more than a graze, so I felt no compunctions about leaving him. My diary records that we reached camp at 7 p.m. having been on the go for 13 hours.

The mistake I made over this bull was in not waiting till his shoulder came into view. A bison's brain is small, and one has to be very steady to hit it. If I could have rested my rifle against the side of a tree, I feel sure that I could have laid him out on the spot, but no tree was available as we were in the open. This bull carried a magnificent head, his massive horns having a very wide spread, with only a slight turn-up at the tips. It was entirely my own fault that I failed to bag him, and it was many years before I saw his equal.

I hope that this account of the mistakes which I made in my early days after bison may be of use to others.

BURMA

Two years later my Regiment moved to Burma, and during the 6½ years I spent in that country between 1911 and 1921, I was able to renew my acquaintance with bison on a number of occasions. I soon found that to secure the willing co-operation of the village shikaries (moksos), a knowledge of Burmese was essential, so got on to that as quickly as possible, and found it made all the difference. Most of my shooting was done in the wet zone, where the jungle was far denser than anything I had come across in India, and more often than not efforts to view an animal merely resulted in his bolting, without affording the chance of a shot. I know of nothing more exasperating than to find, after many hours arduous tracking, that one's quarry, though literally within a stone's throw, is for all practical purposes invisible. To show the nature of the jungle, I will give two instances.

In June 1914 I was in camp at Teinthaw some way north of Bhamo, and on the 8th started out rather later than usual, as I had fever the night before and was not feeling too fit. At noon we found fresh tracks and followed them till 1 p.m. then halted for a couple of hours as the bull would be lying up. Resuming tracking at 3 p.m. we found his sleeping place half an hour later, and came up with him at 4.30. He was only 20 yards off, but the jungle was so thick that I could see only a small patch of black hide, and could not make out which way he was facing, let alone the size of his head. Before I could get a better view, a puff of wind betrayed us and he bolted. Camp was some hours away, and as I did not feel fit enough to sleep out, we left him.

Four days later, having moved camp in the meantime, I started out at 4.30 a.m. and about 7 found the fresh tracks of a very large bull. We came up with him at 8, and again at 8.30 and 9.15, but he was moving fast and evidently suspicious, and I could get no chance of a shot. The jungle was almost impenetrable, and though on one occasion we got within 30 yards, I could see nothing of him. Finally we had to give it up as a bad job.

Of course in both these cases I could have fired 'on spec' in the hope that the bullet would find the right spot, and that the head would prove to be a good one. But I have always considered it unsporting to fire at any animal in dense cover where one cannot be certain of placing an accurate shot, and little short of criminal to fire at a dangerous one under such conditions. The chances are that the animal will escape to die a lingering death, and it may prove a menace to some unfortunate villager who happens to stumble on it. If sportsmen were more careful over their first shots, we should hear less of animals lost, and of regrettable incidents.

I had Government elephants with me in camp, and could no doubt have got a shot off one at either of these bulls, but to my mind that way of shooting bison is simply slaughter and not sport. It offends against the cardinal principles of sportsmanship in that neither risk, nor physical exertion, nor skill in jungle-craft is involved, while even a third class shot should have no difficulty in hitting a bison gazing with bovine unconcern at a range of 30 yards.

But I digress, and the impatient reader may well ask when I am going to give an account of shooting a really worthwhile bull. I can only reply that everything comes to him who waits, as the monkey found when he had sat long enough on the bee-hive. But I should like to make it clear that this is no tale of slaughter, and that of the hundred or more bulls to which I have worked up, those fired at may be counted on the fingers of one hand.

To resume. My experiences in the Pegu Yomas and elsewhere were much the same as at Bhamo, and my memories of bison in Burma, apart from the wonderful bird and insect life of the jungle, are chiefly of a sense of frustration, of the intolerable nuisance of the leeches, and of the pouring rain. In connection with the last I had a useful object lesson one day on how to make fire when our matches had become sodden and useless. The *moksos* cut a section of dead bamboo about a foot long and two inches in diameter and split it down. In one piece they cut out a slot length-ways, with a small groove above it at right-angles—the other was sharpened along the edge and the fine shavings placed beneath the groove in the first piece. The sharpened edge was then rubbed hard against the groove, and in under half a minute a spark materialised which set fire to the shavings. All this was done in pouring rain with very inadequate shelter. I kept the pieces of bambo for many years as a memento of a very ingenious contrivance, but borers got in, and they perished.

One other memory deserves recording. Going along a jungle path one day during the monsoon, we met a couple of small murrel jerking themselves forward, very literally 'Fish out of water'. They were no doubt making their way from one flooded area to another, but the path they were on, though wet with rain, was definitely not under water. It is of course well known that murrel can live out of water longer than other fish, and that they bury themselves in the mud when tanks dry up, but to meet a couple in the open, certainly 50 yards from any water, seemed to me rather extraordinary.

NILGIRIS

The pursuit of bison in Burma was generally very arduous, and at times involved sleeping out on the trail. In Canara conditions were not so difficult, but it was not till I settled down in the Nilgiris that I found how easy it can be to bag one of these grand animals. They are of course no longer found on the plateau, except for a very occasional wanderer, but in the low country they are so numerous that seldom a day passes without seeing them, or at least finding fresh tracks. I am referring here to the Mudumalai, Benne, and Muthunga forests, and not so much to the Anaikatti range, where conditions are less suitable, and where they are restricted mainly to the slopes of the hills. The forest between Masinigudi and Teppakadu is a favourite locality, and to show how numerous they are, I may mention that during a 3-day camp in June 1949, I came across no less than four herds, all containing bulls with shootable, though not large heads, and quite a decent solitary, while G. working in another direction, met two solitaries, one of which was considerably above average. In these jungles tracking is seldom necessary, as the forest is open and the animals can be seen from some distance. Once viewed, a cautious approach will bring one within easy range.

The oft-repeated statement in shikar books that bison are shy retiring animals and avoid human proximity, most certainly does not apply to the Nilgiris. I have shot a bull within half a mile of the Mudumalai Game Hut, and it is quite common to see a herd feeding close to the main road to Mysore, and paying but little attention to passing cars. Even solitaries when met with deep in the jungle show little concern, provided of course that the wind is in one's favour. One I remember meeting up the Doddakatte path early one morning in June 1940. At the time we were sitting watching a herd of chital, and trying to decide whether the stag, which was roaring, was worth shooting. Suddenly we became aware of a bull which fed across our front not 50 yards away and did not even favour us with a look, though we were right out in the open in very short grass, with not a tree or an ant-heap anywhere in the vicinity. I saw that he was not shootable, and as he was moving very slowly and I wanted to get on, we left the path and went round by the right passing him at 30 yards. We talked at him and even shouted, but he paid not the least attention, and it was not till our movement so close caught his eye that he looked up, gave a terrific snort, and bolted, the tuft of his tail swinging comically as he jumped over a bush.

ARE BISON AGGRESSIVE?[1]

The popular idea that bison are dangerous animals is not borne out by my experience of them, as shown by the incident above, which is only one of many. A wounded animal may of course give trouble, but if not molested they are, in my opinion, no more dangerous than domestic cattle. My old Kurrumba shikari Kempa, (who is shown at the head of the Doddakatti tigress in the photo with Part I of this series), did however warn me that if repeatedly followed up and disturbed, they might resent it. At the time I was trying to get photos of a small herd, and my very inadequate hand-camera necessitated so close an approach that at each attempt the animals were alarmed and bolted before I could secure a picture. After three abortive attempts Kempa advised me to give it up. 'You may move bison twice and sometimes three times without trouble' he said, 'but if you go on worrying them, they will turn nasty'. The old man's knowledge of the jungle was unrivalled, and I never knew him wrong, so rather unwillingly I abandoned further attempts to obtain photographs.

That was a good many years ago, and since then I have repeatedly come across bison and have always found them timid and inoffensive—so much so that I have not the least hesitation in walking straight towards them in the open, and their re-action invariably has been to bolt after a good look. But one never ceases to learn in the jungle, and on the 2nd December 1948 an incident occurred which proved that old Kempa was perfectly correct, and that a bull, if molested, may prove aggressive even though not fired at.

At the time we were after small game some 6 miles downstream of Anaikatti at the foot of the northern slopes. The covert to be beaten was an isolated patch of jungle not of great extent, but heavily bushed. I was the centre gun, and an open glade some 20 yards broad ran in a straight line on either side of me. Soon after the beat started a peahen came out past the left gun who fired both barrels at it, and I then heard the beaters, who were still some 100 yards away, shouting that a bison was coming towards us. A few minutes later I heard it moving through the bushes in front. My rifle was lying on the ground close by, but I did not bother to pick it up, as I had no reason to expect trouble, and I knew there was no really good head in that area. I did however, as a precautionary measure, move back a few yards towards a tree, at the foot of which my shikari Kunmada, and my chokra were sitting. Suddenly the bull's head appeared from the bushes about 25 yards away on my right front, and I expected him to break past me on the right, as he could easily have done. But after a good look he swung round, put down his head and charged straight at me. There are occasions when discretion is the better part, and this was obviously one of them. I nipped back behind the tree just in time, and as he dashed past saw him make a vicious sweep with his horns, but luckily we were all under cover. Having made his point he swung half-right and went off with his head up. He was a young bull of deep chocolate colour, and his horns had a spread of not more than 30 inches, but his bulk was very imposing as he rushed past literally within arm's length. As he charged, Kunmada shouted loudly at him, but without the least effect. This was no affair of a startled animal making a blind rush, such as any sportsman of experience will have seen time and again, but a deliberate head-down charge. He could have got away straight to his front, or to his left, without coming any nearer to us, but I suppose that with the beaters shouting behind he thought he was cornered. That seems to be the only explanation, and it shows how the unexpected may occur in the jungle at any time—Kunmada told me that he had never known a similar case. It was extremely lucky for me that I had the tree handy—as it was, though the bull had to cover 25 yards to my 5, he nearly beat me to it. There was of course no question of using my rifle, as it was out of reach lying on the ground—the bull went over both it and my shooting stick but without touching either.

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[1] This episode has already appeared in the *Journal* for April 1949, but is republished here for the sake of completeness.

SOFT-NOSED *versus* SOLIDS

When one has shot a few bulls, my own feeling, with which I think most sportsmen will agree, is to hold one's fire unless one encounters an exceptionally fine head. Bison are such grand beasts, and in the Nilgiris at any rate, so easily bagged, that to continue shooting ordinary bulls just for the sake of shooting, seems to me more slaughter than sport—besides the meat is nearly always wasted, as very few jungle tribes in India will touch it.[1] The last bison I shot was in 1930, and though I have met many solitaries since then none has come up to the 40-inch limit which I have set myself. As the story of my last bull exemplifies the relative values of soft-nosed and solid bullets when used on bison, I give it here.

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[1] That bison meat should be repugnant to Hindus is only natural, but illogically enough the same aversion extends in many places to the flesh of the Nilgai, though the latter is of course an antelope, and except in name has no connection with the Bovidae. The subject of cow-worship, though scarcely relevant to our subject, is of such interest as to deserve mention.

Exactly how and when the cult of the cow originated is unknown, but it is certainly not of great antiquity. In early times the cow was the unit of value, and cattle the measure of a man's wealth, but it was not till the time of the Emperor Asoka Maurya that any protection was afforded to them, and then only to a limited extent. Pillar Edict V of 243 B.C. lays down an elaborate code of regulations restricting the slaughter of many animals, but the killing of cattle for food (except Brahminy bulls and milch cows) continued to be lawful. This is confirmed by the *Arthasastra* of Kautilya, and the exceptions given seem to mark a definite transitional stage in the cult of the cow, which till then had not been an object of reverence. However that may be, the fact that bison meat is *taboo* is a fortunate occurrence, as it may save this grand animal from the extinction which is rapidly overtaking the deer tribe, owing to the virtual abrogation of the Game Laws and the indiscriminate slaughter of all edible animals which now prevails.

We were in camp at Mudumalai at the time, and on the 7th May I started up the Doddakatti path before dawn to visit a bullock which had been tied up for tiger. We found the bait untouched, so turned down the forest path towards Honurhatti, and soon heard a chital stag roaring in the valley below us to the north. As we moved down the slope towards it, we suddenly put up a solitary bull which galloped away downhill. He was jet-black and I could see that his horns were fine ones, projecting well beyond his ears. I fired and knew that I had hit, so followed and soon found a dropping and a pool of blood. The tracks now led into some very thick stuff, and while watching the men puzzle out the line, I noticed what looked like a large grey rock, indistinctly visible in the bushes some 20 yards ahead. Suddenly there was a tremendous snort, and the trackers wisely dived right and left into cover as the grey rock materialised into the bison, which however bolted before I could fire. I ran after him and got in two quick shots as he went off, the first hitting rather far back, as we found later, and the second a miss. We again resumed tracking, and after about 200 yards came up with him again, still in such terribly thick undergrowth and long grass that I could not make out how he was standing. However, with a wounded animal, it pays to take every possible chance without loss of time, so I fired at what I thought was his shoulder, quite forgetting that I was still using soft-nosed bullets. The shot knocked him over, but he recovered and went off again with me in hot pursuit. As I came to the edge of a clearing, I saw him standing tail-on about 45 yards away. I was out of breath from running and far from steady, so moved forward a few yards to a sapling to get a side-rest for my rifle. The bull must have heard me, as he swung round offering the chance of a brain shot, and it was then only that I remembered what bullets I was using. To open the bottom of the magazine, let the cartridges fall on the ground and press in a clip of solids took only a few seconds, by which time the bull had turned slightly to his right to stare at the men following me, and exposed the point of his shoulder. I fired at it, and the way he crashed down and out made me regret that I had not changed to solids earlier. It was lucky for me that he did not charge while I was reloading, but I felt that I simply had to take the risk. My rifle on this occasion was a ·423 Mauser. Had I been using a lighter bore, I should probably never have seen the bull again after the first shot, and certainly could not have anchored him so soon. Undoubtedly I could have finished the affair more quickly if I had reloaded with solids at once after firing the first shot, but I did not think of it at the time. Soft-nosed bullets are all very well for a heart shot inclining forward behind the shoulder, but for quick shooting when large bones may be encountered, the greater penetration of the solid tells every time. I have myself killed a bull with a single soft-nosed ·405 bullet behind the shoulder, but I also know of two cases at Mudumalai where sportsmen fired 17 and 13 shots respectively (all soft-nosed ·375 ordinary) before they could finish off their bulls. I shall refer to this again later.

A FORTY INCHER

I am still waiting to bag a 40 incher. But I did put up a bull only two years ago which certainly reached, and probably exceeded my limit. As we were going along the Benne road one morning soon after dawn, I heard a rustling in the long grass on the bank above us. My driver quickly handed me the heavy rifle, but I could see nothing and did not realise what it was till the bull, which had been watching us through the tops of the grass not 20 yards away, swung round and went off, giving a momentary glimpse of magnificent horns with those very blunted points which not only indicate age, but add so much to the value of the trophy. Before I could raise my rifle he had disappeared in the dry 6-foot grass, where I soon found it hopeless to follow him, and though we spent several days looking for him we never met again. Whoever shoots that bull will obtain a very worthwhile trophy.

BISON KILLED BY TIGER

Bison at times fall victims to tigers. In May 1939 some miles from Mudumalai, I found the remains of a large cow which had met its fate in this way. The kill was about a month old when I came across it, but sufficient remained to show a badly twisted hock, no doubt where the first attack was made, and claw marks on the face. The horns had been removed by the Forester who assured me that there could be no doubt that the kill was by a tiger. I heard of similar kills towards Benne and at Doddakatti, and a party of American sportsmen some years before the last war, came across three tigers feeding on a cow bison which they had killed down the Thoraipalli road, and bagged one of them. All these cases occurred in the Mudumalai forest of the Nilgiris, where bison were, before the war, particularly numerous. At Anaikatti also, where comparatively few are to be found, a mature bull was killed by a tiger in August 1938. The skull of this animal can be seen in the forest bungalow there—the horns are of good girth, but the spread is poor. Besides cases reported, there must be a number of bison killed in this way whose remains are never found, and it seems probable that more are killed by tigers than is generally realised.

SOME HINTS

The following notes will, I hope, prove useful to those who have not yet gone after bison :—

The sportsman who restricts himself to solitaries, should not be in too great a hurry to fire at a single animal on the assumption that it must necessarily be a bull. Twice I have encountered solitary cows, very black aged beasts, which for some reason had left the herd, probably on account of sickness or old age. In such cases the size of the tracks should arouse suspicion before the animal is sighted, but the tracks even of a bull are not necessarily proportionate to the size of his head. The biggest tracks I ever saw were of a herd bull on Kortaybetta hill near Kollegal. We had to follow some way before coming up with their owner, and then found a herd of some 20 animals in such long grass that a clear view of the bull's head was impossible. I climbed a tree to have a look, and was disappointed to find that it was after all a poor one. Incidentally, in such cases the morale of your men will be improved if you send them up the tree first—otherwise they may think you are frightened!

The traditional idea that a solitary is always an aged worn-out beast which has been turned out of the herd by a younger animal is not supported by facts. It is very seldom indeed that a herd bull carries a really fine head, whereas the solitary nearly always does, and moreover is generally an animal of such physique that he could knock any herd bull into a cocked hat. There are of course a few which are really solitary on account of old age or sickness, but there can be no doubt whatever that the great majority of solitaries are so only temporarily, and rejoin a herd for a short time at the mating season. It therefore pays always to examine a herd in case this has happened. Solitaries are often accompanied by a young bull, which whether intentionally or not, acts as guard while the senior takes his siesta. If therefore you put up a young bull, you may be pretty sure that the old gentleman is close by—it is most unusual to find a youngster on his own.

Horns vary enormously, not only in length and spread, but also in girth, and it is for this reason that some game licences very reasonably lay down an alternative definition of a mature bull—spread *or* girth. In some heads girth is comparatively poor, though the spread is good; others have good girth, but the horns are short with little spread; others again have great spread, but with the points of the horns worn down and blunted—it is these which discerning sportsmen prize most. When mounting horns with only the skull, as is usually the case, appearance is improved if the latter is kept complete, less of course the lower jaw. A mere frontlet of bone detracts from the appearance of the head. As already stated, when estimating the head of a living animal, provided that the horns project beyond the tips of the ears, the bull should be a shootable one.

The poetry of big game shooting is to finish the business with a single shot, and if you can get close enough, a bullet in the brain or in the centre of the neck will do the trick. If you have to take a body shot make sure, so far as possible, that the first shot is a disabling one, and for the necessary penetration use solids. As regards the rifle, no bore smaller than ·400 H. V. should be used, in fact this is generally laid down in the conditions of the licence. I have already referred to the difficulty experienced by two sportsmen in killing their bulls with the ordinary (not Magnum) ·375, and for the sake of comparison of various bores, I give below a table showing the relative striking energies at 100 yards range—the figures have been extracted from Major Burrard's *Notes on Sporting Rifles*.

·318 bullet 250 grs.	...	2,580	foot lbs.
·375 (ordinary), bullet 270 grs.	...	1,920	,,
·375 (Magnum), bullet 270 grs.	...	3,400	,,
·404, bullet 400 grs. ...	...	3,310	,,
·405 (Winchester), bullet 300 grs.	...	2,510	,,
·423 (Mauser), bullet 347 grs.	...	2,940	,,
·470, bullet 500 grs.	...	4,060	,,

I leave readers to draw their own conclusions from the above, but I might mention that a brother officer who used an ordinary ·375 extensively in East Africa during the First World War, informs me that he found it useless for the larger antelope, and that a service ·303 proved far more effective, even for a side shot at rhino.

Sooner or later, you will almost certainly have to follow up a wounded bull. In that case it is better to leave the tracking entirely to the shikaris, and to concentrate on watching for the animal, which may be lying up awaiting a chance of reprisal.

Bison shooting is grand sport, but it should never degenerate into slaughter. Stalk your bulls fairly, and do not degrade yourself by shooting them from an elephant or out of a car. When you have shot one or two restrict yourself in future to really good heads. How many you shoot is of course a matter of personal inclination, but half a dozen bulls in a man's lifetime should be enough for most people. My own modest total has not reached even that figure, and the single head which I have kept looks down from my walls to remind me of the final scene of our encounter when the bull faced me in the open, and I had to reload with solids behind that very inadequate sapling.

WILD CATTLE

Apart from bison, were there at any time wild cattle in S. India ? To many the idea will seem ludicrous, but I once picked up an old book entitled *Nilgiri Sporting Reminiscences*, in which the author quotes that well-known sportsman of old days, General Morgan, as having come across a solitary wild bull in the valley behind Bangi Tappal about 1850. Gen. Morgan describes the animal, which he viewed from a distance of only 25 yards, as follows : 'Let the reader fancy before him a magnificent Brahminy bull, the blackness that of midnight, of a stature far surpassing anything seen in the domestic state, with an enormous hump and dewlap; white blaze on the forehead; straight horns gently curving upwards, set on at right angles to the head, like an English bull and about a foot in length; head small, muzzle thorough-bred; legs as fine as an Eland antelope, with four white stockings, and a tail with a bushy tuft that almost swept the ground. Now let us contrast this with a bull bison I killed the next morning—hump low but long, blaze on face grey, horns semi-circular, legs thick and dirty white stockings, tail ending at hock with but a small tuft of hair. The two animals were as different as they well could be.' Gen. Morgan fired at the bull, but was deceived by the enormous hump, and the bullet was too high. It entered a shola, and while following it up, he came across the fresh droppings of an elephant, which he went after, being sure that the bull was mortally wounded. But, as so often happens when one changes one's objective, he failed to locate the elephant, and then when he returned, could not find the bull either. After relating his disappointment, Gen. Morgan continues: 'I may mention that Dick Sullivan when Assistant to the Collector of Coimbatore, told me when I mentioned the case to him, that he was well aware that wild cattle came down close to the Kullar river at Metapoliam from the upper sources of the Bhavani. I firmly believe that in those vast forests and unexplored tracts, wild cattle, the *Bos frontalis* of naturalists, may and will yet be found by future sportsmen.'

In those days the Gayal or Mithan (*Bos frontalis*), was classed as a distinct species, though it is now known to be merely a hybrid between the bison and domestic cattle, being kept in a partially domesticated condition by the hill tribes of Assam and the Indo-Burmese hill ranges. The possibility of its existence in the distant Kundahs of the Nilgiris intrigued me, and I decided to investigate. I knew the valley behind Bangi Tappal where Gen. Morgan met his bull, and was quite certain that wild cattle were no longer to be found there or in its vicinity, but some miles beyond is an area known as 'Big Bison Swamp' so cut off by nature and difficult of access, as to be seldom visited by any human being. The Badagas who graze their herds of buffaloes and cattle in the Kundahs during the hot weather, never penetrate so far, while to the Kurrumbas in the Bhavani valley 4,000 feet below, access is denied by the precipitous slopes covered with almost impenetratable primeval forest—nor indeed is there anything to attract them. From enquiries which I made, it did not appear that anyone had visited the spot since the early eighties, and there if anywhere might be found corroboration of General Morgan's story.

In April 1932, after 3 days marching, I reached Nadgani, some 8 miles beyond Bangi Tappal, and camped there since this was as far as pack-ponies could conveniently be taken. At dawn next day we started on our voyage of discovery. After descending about a mile to the Yemavipuzha stream, we climbed the steep ridge to the left, which brought us on to the more or less level ground running up to Angindamalai, the pyramid-shaped peak which can be seen from Ootacamund. The going was very bad indeed, as the long tangled grass concealed many rocks and loose stones over which we were constantly stumbling. There were no game paths, and since the Badaga herds never come so far, the grass had not been burnt for very many years. Fortunately before long we struck an elephant path, such as I had previously seen in the low country between Masnigudi and Teppakadu. It was some 18 inches broad, beaten down hard and flat by the passing of countless herds, and so smooth that one could have cycled along it quite comfortably. From its direction it obviously connected up somewhere with the Sispara bridle path, and would have afforded a much easier, though longer, means of access to Anginda than the route we took. We ascended the peak, and found elephant droppings on the bare summit which the map showed to be 7,819 feet above sea-level—what induced the animals to climb up there I cannot imagine.

From this projecting bastion of the Nilgiris the view was superb. Far below lay the picturesque patchwork of Kerala's paddyfields and homesteads, clumps of bamboo and jungle, interspersed here and there with the gleam of water, the whole merging gradually into the darker belt of coconut palms which fringe the coast, and beyond that again the sea rose like a tilted wall. So clear was the air that with the naked eye I could see a steamer and several dhows to the south of Calicut, while the glasses revealed numerous small fishing boats, though over 40 miles away. It was hard to tear oneself away from such an entrancing spectacle, but time was passing and our objective lay still some distance away, as we could see. So we descended to our 'Grand Trunk Road' which soon after led us along a knife-edge with a nasty drop on either side, and then to the top of a cliff. I wondered how we were going to negotiate it, but the track went on down in zigzags, wonderfully engineered, till it again reached the level. It is, no doubt, this section of the path to which General Hamilton refers in his *Records of Sport in Southern India*, in which he says: 'One cannot help being struck with the skill with which these paths are traced; the gradients are truly wonderful, avoiding every steep and difficult ascent by regular zigzags, and I could not help thinking what a knowing old engineer the first maker of the track must have been'.

From the bottom of the cliff the ground rose, and still following the path, we at length reached Big Bison Swamp. There I made a most careful search for signs of wild cattle, but could find none, nor indeed of any other animals except elephants, which obviously visit the spot in considerable numbers every year. Beyond the swamp the track led over a col down into the 'Silent Valley', still mostly unexplored, and concerning the deadliness of which my shikari, 'Old' Anthony, had some wonderful stories of shooting parties which had entered it and never returned! Whether its evil reputation is due to innumerable leeches, or to the presence of hamadryads, or to some other cause, it is, I believe, a fact that with the exception of elephants, no animal is to be found there. We ourselves noticed the complete absence of bird and animal life once we had reached the base of the cliff which I have mentioned above, though till then there had been no dearth of it. A dead silence seemed to brood over the area, and no apter name could have been given to it than the 'Silent Valley'. The shikaris were most unwilling to explore further, and anyhow there was no time, so we started back. Of our return journey there is little to relate. After ascending the cliff and passing round Anginda, we came across a herd of Nilgiri ibex and I had a fleeting chance at a saddleback, but the clouds had come down and visibility was poor, which must be my excuse for missing it.

And so ended a trip, which if unsuccessful as regards the main objective, still remains a most interesting memory. Though we found no traces of wild cattle, still I think that Gen. Morgan's story may be accepted without reserve, as he was a very experienced sportsman. I imagine that the bull he saw was either a hybrid bison, or else the descendant of domestic cattle which had gone wild during the fourth Mysore war, which after all was not so many years previous to his unique experience. Whatever the solution, I can hardly believe that any wild cattle exist in the Nilgiris today. Perhaps some younger and more energetic sportsman will be encouraged by this account to follow my footsteps and make a further search. To the best of my belief, no one has visited that area since I was there.

TSINE

While I was in Burma, I spent a good deal of time, on and off, in the pursuit of tsine, which I soon realised were far more alert than even bison. Yinmabin, on the Kalaw ghat and some 30 miles from Meiktila, was in those days an excellent centre for them, but I was greatly handicapped by my military duties, which allowed me only an occasional day in the jungle. The latter being fairly open, I managed on a number of occasions to work up to both herd bulls and solitaries, but failed to find one up to the standard I had set myself as shootable. I wanted a really good head or none at all, a policy which, I am afraid, was not very popular with my *moksos*. There was one very fine old bull near Yebokson, some 6 miles beyond Yinmabin, and I tracked him often but never could get a shot. He always spotted us first, and all that happened was a snort, a crashing through the jungle, and very occasionally a fleeting glimpse as he bolted. I have mentioned previously how important a factor luck is in big game shooting, and it was luck pure and simple which eventually gave me this bull with a minimum of effort.

On the 13th April 1920 I left the Rest House at dawn for Yebokson, intending to pick up the tracks which we had abandoned the evening before. Ten minutes after leaving Yinmabin, my Burmese driver suddenly pulled up the car, and said 'What is that'? Looking to the right, I saw a fine bull not 40 yards away, staring at us. A moment later he went off, and running after him I managed to get in two shots, the second of which brought him down with a crash. I shouted to the driver to go on to Yebokson and bring the trackers, and when I turned round again, I found that the bull had picked himself up and disappeared. I decided not to wait for the men, but to track him myself. There was no blood for 50 yards, then quite a lot, light-coloured and frothy, so I knew a lung was pierced, while it appeared that a hind leg also was broken. I soon saw the bull going off slowly, so ran on and as I came up, he turned round to face me, pawing the ground and snorting. I fired two hurried shots, but was unsteady, and one missed. I expected a charge, but he went off again and disappeared from sight. Knowing the tsine's reputation, I followed the tracks very cautiously, but had not gone far when I saw something waving in the grass on my right front. It was a hind leg feebly kicking—my third shot had passed through the neck, but he had covered another 140 yards before collapsing, and then required a finisher. The bull proved to be a very old one, with the mark of a previous bullet wound on one hind leg, while the horns had an unusually fine spread. I must confess that it was in a very satisfied frame of mind that I sat down to smoke a cigarette and await the arrival of the men. It was only half a mile or so to the road, so it was not long before they arrived, beaming at the idea of so much meat. My *mokso*, Ko Po, then pointed out to me a fact which I had overlooked in the excitement of the chase, viz.: that this was the identical animal which had previously given us the slip so often. Admitting the amazing luck of my meeting the bull as I did, still I think I am justified in regarding this as one of my most satisfactory jungle memories, since I was single-handed, and had to rely on myself alone. Not that the tracking presented much difficulty, for though the ground was hard, there was a fair blood trail—but I had to both track and keep a good look-out at the same time, which was not so easy.

(*To be continued*)

NOTES ON SOME ASIATIC MEROPIDAE (BIRDS)[1]

BY

DANIEL MARIEN

(*With a map*)

(*Communicated by Dr. Ernst Mayr—New York*)

INTRODUCTION

Receipt of 267 specimens of bee-eaters (Meropidae) in the Koelz Collection from India and adjacent countries has permitted a revision of the Indian species of this family. The family Meropidae is represented in India by the genera *Merops* (5 species) and *Nyctyornis* (1 species); related species of these genera are distributed throughout most of the Old World tropics and sub-tropics. In habits and appearance the Indian forms agree with other members of this family. Although these species are fairly well known taxonomically, there is still much to be learned about their distribution, migrations, plumages, and molts. Statements in the literature on these points are often misleading or lacking. In this review particular attention has been given to plumage sequence, seldom discussed in the standard references, yet in some instances a useful zoological character.

I am grateful to Dr. Walter Koelz for the privilege of examining his extensive collection. Drs. Ernst Mayr and Dean Amadon have directed and encouraged me in this study and I am greatly indebted to them for their helpful suggestions and kind advice. My thanks are due also to Capt. Jean Delacour for measurements of *M. leschenaulti* in the British Museum.

PLUMAGE AND MOLTS: The sexes are alike in coloration; females average smaller in size. The immature plumage somewhat resembles that of the adult but is generally duller. In those species with elongate central tail feathers these are acquired, along with the fully adult plumage, before the second summer. The post-juvenal molt normally takes place during the late summer and autumn but certain exceptions are to be found.

There is always one complete molt annually. The time and progress of this molt varies among the species; details will be found in the discussion under each form.

The primaries apparently initiate the molt or at least start concurrently with the body molt. They are replaced progressively and singly from the innermost; each wing is normally at the same stage. The secondaries are among the last feathers renewed; molt is begun at each end of the series and proceeds to meet at the middle of the row. The tertials are probably replaced independently of the secondaries.

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[1] Notes from the Walter Koelz Collections, Number 5. The previous papers in this subseries are: Number 1, *American Museum Novitates*, no. 1406, 1949; Number 2, *American Museum Novitates*, no. 1424, 1949; Number 3, *American Museum Novitates*, no. 1425, 1949; Number 4, *American Museum Novitates*, no. 1459, 1950.

The tail molt does not begin until the fourth or fifth primaries are already out of their sheaths and is completed before the end of the wing molt. Friedmann's paper on the caudal molt of some non-passerine birds (1930, *Proc. U. S. Nat. Mus.*, 77(7): 1-6) states that the tail molt of *Melittophagus revoilii* is irregular. This was the only bee-eater studied by Friedmann and suggested an investigation of the present material to determine the order of rectrix renewal in the six Indian species. The sequence of the caudal molt was found to be constant within each species, and for convenience will be expressed by means of a simple formula. For example, in *M. apiaster* molt begins with the central pair (1). The pair next alongside these (2) follow shortly, then the outer tail feathers (6) are replaced, and after these the third pair from the centre (3). Molted next are the pair inside the outermost feathers (5), and lastly the next inner pair (4). The tail molt pattern can thus be written: 1, 2, 6, 3, 5, 4. The order of rectrix renewal is given in Table 1 below.

TABLE 1

Order of rectrix renewal of six Indian bee-eaters

Species/Subspecies	Tail Molt Pattern
Merops l. leschenaulti	1, 2, 6, 3, –, –[a]
M. apiaster	1, 2, 6, 3, 5, 4
M. superciliosus persicus	1, 2, 6, 3, 5, 4
M. p. philippinus	1, 2, 6, 3, 5, 4
M. o. orientalis	1, 6, 3, 2, 4, 5
Nyctyornis athertoni	1, 2, 3, 6, 5, 4

(*a*) full sequence indeterminable with present material.

In these forms the pattern of rectricial ecdysis does not appear to have systematic significance above the specific level. It is possible that the molt sequence would be found to vary geographically if a large series of molting individuals of different subspecies were studied.

MEASUREMENTS: All measurements are given in millimeters. Bill length refers to a measurement taken from the anterior border of the nostril to the tip of the culmen. The length of the wing was taken with the wing pressed flat on the rule. Wing-tail index, where given, is the ratio of the length of the tail to the length of the wing expressed as a percentage of wing length. Similarly, the tail-bill index is the ratio of bill length to tail length expressed as a percentage of tail length. With the exception of *M. leschenaulti* and *N. athertoni* the measurements are only those of the specimens in the Koelz Collection and are of fully adult unworn birds.

LOCALITIES: Under each species and subspecies heading a list is given of the specimens collected by Dr. Koelz. These previously unpublished records should be useful in mapping the ranges and migrations of these species.

Merops leschenaulti

The Bay-headed Bee-eater is widespread in the Indo-Malayan Region, but in the Greater Sunda Islands it occurs only on Java and Bali. A very similar species, *M. viridis*, is present on Sumatra and may replace it ecologically, though both species occur in southeastern Asia, Java, and Bali.

There is some individual variation in color in the species, chiefly in depth of color of the head and back, but there is considerable geographic variation among populations. The Java and Bali birds, *quinticolor*, are, even in freshly molted specimens, bluish on the upper surface of the tail and the tips of the secondaries. Members of the other populations have these areas normally green, but they often become blue through wear. The chestnut pectoral band bordered posteriorly by a black band is absent in *quinticolor;* only the black band is retained.

There is also considerable geographic variation in size; Table 2 shows the measurements of three populations within the species.

These measurements indicate that the Andaman Islands birds are larger, with longer tail and wings; the Java and Bali birds are shorter-winged and shorter-billed; the mainland birds are intermediate in size.

On the basis of the above-mentioned differences *Merops leschenaulti* can be divided into three subspecies as follows:

Merops leschenaulti leschenaulti Vieillot

Assam: Khasia Hills, Nongpoh, May 2-6, 1949, 4 ad. ♂, 3 ad. ♀. United Provinces: Kumaon, Tejan, June 4, 1948, 1 ad. ♂, 1? imm. ♀; Kathgodam, August 19-20, 1 ad. ♂, 2 imm. ♂. Nepal: Hitaura, May 20-June 13, 1947, 5 ad. ♂, 4 imm. ♂, 2 unsexed imm. Bastar: Korher, March 25, 1949, 1 ad. ♂. Southern Madras Presidency: Nilgiri Hills, Kunjapanai, February 19-20, 1937, 3 ad. ♂; Nilambur, March 3, 1 ad. ♂. Southern Bombay Presidency: Jagalbed, February 21-March 4, April 14, 1938, 5 ad. ♂, 5 ad. ♀; Castle Rock, March 5-6, 2 ad. ♂, 2 ad. ♀.

Type locality: Java, error = Ceylon.

Range: Ceylon and the west coast of India north to Belgaum; the United Provinces, Nepal, Assam, Orissa, eastern Bengal, to Burma, Yunnan, Siam, and French Indo-China. Chasen (1939, *Bds. Malay Peninsula*, **4**: 100-101) says he knows '. . . of no reliable record from south of Kuala Kangsar in Perak . . .'. There are, however, several specimens from Pahang in the collection of the American Museum of Natural History, two from Gunong Tahan and two from 'Sungei Lebih'. Therefore, about five degrees north latitude seems to be the southernmost limit of the range in Malaya.

Freshly molted birds are dark green on the back and a rich chestnut brown on the crown and nape. Like other members of the genus,

TABLE 2

Measurements of adults of *Merops leschenaulti*

Region	N	Wing	N	Tail	N	Bill
Mainland	32♂	104–113 (107·4)[a]	29♂	78–85 (80·9)[c]	36♂	25–32 (28·6)[e]
	29♀	100–112 (106·0)[b]	30♀	75–84 (79·6)[d]	30♀	26–30 (28·0)[f]
Andamans	14♂	107–115 (111·2)	14♂	81–94 (88·5)	12♂	26–34 (31·0)
	8♀	107–112 (108·7)	8♀	85–97 (90·1)	8♀	29–32 (30·4)
Java, Bali	8♂	95–105 (99·4)	9♂	75–83 (79·2)	9♂	24–27 (25·4)
	4♀	97–102 (99·0)	4♀	80–82 (81·5)	4♀	24–28 (25·4)

a $\sigma = 2{\cdot}3$ *c* $\sigma = 1{\cdot}7$ *e* $\sigma = 1{\cdot}6$
b $\sigma = 2{\cdot}3$ *d* $\sigma = 2{\cdot}0$ *f* $\sigma = 0{\cdot}3$

this bee-eater nests in holes along the banks of streams; as a consequence the plumage of breeding birds becomes worn, causing the feathers of the back, wings, and tail to acquire a bluish tinge and the feathers of the head and nape to become paler.

Immatures are distinguishable by their smaller bill and by having the crown and nape concolorous with the back, which is green. The breast markings of immatures are indistinct.

The annual post-nuptial and the post-juvenal molt may take place from late May through October.

Merops leschenaulti andamanensis, new subspecies

Type: A.M.N.H. No. 641320, Rothschild Collection; adult male, Port Blair, South Andaman Island; December, 1897; A. L. Butler, collector.

Agrees in coloration with the nominate race but differs in being larger, with longer tail and wings.

Range: South Andaman Island and probably other islands of the group. Hume (1874, *Stray Feathers*, pp. 163-164) says, 'This species . . . is also found . . . in the Great and Little Cocos, Strait Is., etc., etc. We never met with this species in the Nicobars'. Nesting is apparently in the middle of May.

Merops leschenaulti quinticolor Vieillot

Type locality: Ceylon, error=Java.

Range: Java and Bali.

Similar to the nominate race but distinctly bluer on the tail, lacking the chestnut pectoral band, and being smaller.

Because the breeding season on these islands differs from that on the mainland, the post-nuptial molt occurs during the winter months. November birds in the material studied were very worn, while March and April birds were in fresh plumage.

Merops apiaster Linnaeus

Khorasan: Bardu, August 16, 1940, 1 unsexed imm.; Robat i Khan, September 1, 1 imm. ♀.

Luristan: Durud, April 21, 1941, 1 ad. ♂, May 7, 1 ad. ♀, May 17-23, 1941, 3 ad. ♀, May 24-25, 1940, 4 ad. ♂, 1 ad. ♀, September 7-11, 1 ad. ♂, 1 imm. ♂.

Afghanistan: Turuk Pul, May 10, 1937, 2 ad. ♀; Baghlan, July 1, 1 imm. ♂; Khanabad, July 3-4, August 31, 1 ad. ♂, 2 imm. ♂, 1 imm. ♀; Takia, Kishm, July 6, 1 imm. ♀; Gumbaz, Kishm, July 7, 2 imm. ♂; Faizabad, July 15, 1 unsexed imm.?; Iskan, August 3, 1 ad. ♀; Doao, August 23, 1939, 1 imm. ♂; Balkh, September 19, 1937, 1 ad. ♂, 1 imm. ♂, 1 imm. ♀.

India: Northwest Frontier Province, Parachinar, May 7, 1936, 1 ad. ♂.

Merops apiaster is very uniform over its extensive range across southern Eurasia from the Iberian Peninsula to western Siberia and there are no subspecies. In southwestern Asia this species breeds in Iran, Baluchistan, Afghanistan, and Kashmir. It is highly migratory, wintering principally in southern Africa. The material collected by Koelz seems not to differ from other Indian specimens nor from examples from other parts of the range.

It is known that the molt of this species does not conform to the simple pattern of a single complete molt found in most of the Indian bee-eaters. After the breeding season, in August and September, adults of *apiaster* have a complete body molt into an eclipse plumage somewhat resembling the juvenal feathering. The adults in eclipse plumage may be distinguished from immatures by their worn rectrices and remiges, elongate central tail feathers, and yellower scapulars. On the wintering grounds in Africa adults and immatures alike undergo a complete molt during which both age classes acquire the nuptial plumage. The period of this winter molt falls between the months of October and February.

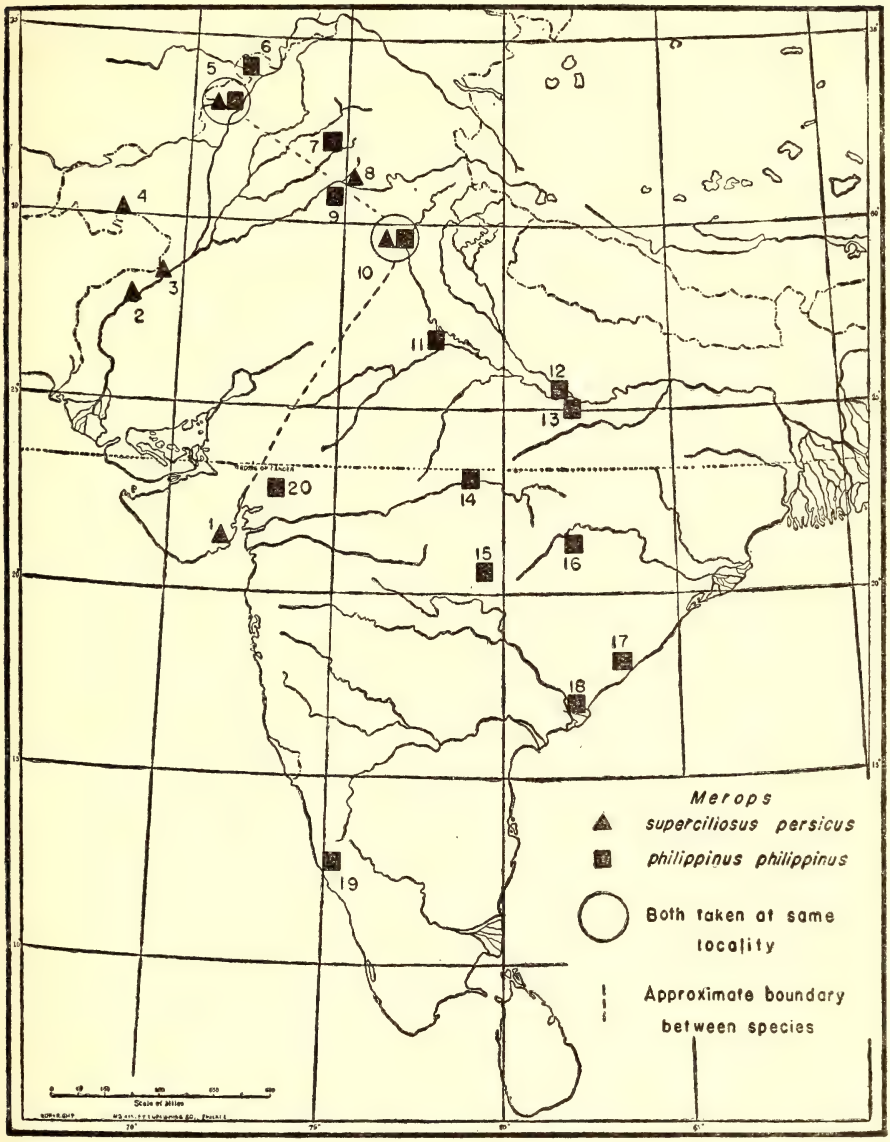
The molts of this species are reminiscent of those of the American tyrant flycatchers, Tyrannidae, which, according to Dwight (1900, *Annals N.Y. Acad. Sci.*, **13**: 136-137), postpone molting after nesting until reaching the winter quarters. Such cases of delayed molts may possibly be adaptations to permit early or extensive migration. Kipp (1936, *Mitt. Vogelwelt*, **35**: 77-78) in a study of migratory Palaearctic passerine birds found that those species whose winter quarters lie south of the Tropic of Capricorn have a winter molt which may be partial or complete. In some instances there is also a partial or complete molt during the summer preceding migration. The condition in *M. apiaster* agrees well with these observations since it winters in southern Africa and has its annual molt while in its southern quarters.

Measurements: Wing; males, 147, 149, 149, 150, 150, 153; females, 141, 142, 143, 143, 146, 148, 148. Tail: males, (central rectrices) 109, 109, 113, 114, 115, 115, 117, 119, (outer rectrices) 88, 89, 89, 90, 90, 92, 93, 94; females, (central rectrices) 102, 104, 105, 106, 108, 110, 113, (outer rectrices) 87, 88, 88, 89, 91, 91, 95. Bill: males, 27, 29, 29, 30, 30, 32, 32, 34; females, 24, 25, 25, 26, 27, 27, 30, 31.

Merops superciliosus and Merops philippinus

Some authors, most recently Peters (1945, Birds of the World, volume V, pp. 234-235), treat *M. philippinus* as a subspecies of *M. superciliosus*, but both groups are in fact quite distinct. There is a western, large, green-tailed form, *M. s. persicus*, that meets the eastern, smaller, blue-tailed form, *M. p. philippinus*, in northwestern India. Because the morphological differences between *philippinus* and *persicus* are not very striking and their ranges are contiguous, one would expect to find clear evidence of intergradation. Yet despite the similarity of appearance and the fact that except for a very narrow zone of overlap they replace each other geographically, no intermediates seem to have been reported. This, together with their physiological differences in molt, migration, and ecological adjustments to different climates suggest that they are not as closely related as would appear—are, in fact, allopatric species rather than subspecies.

Distribution. The distribution of the two species in India is shown in the accompanying map. Because the breeding season varies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13
14
15
16
17
18
19
20
Tropic of Cancer
Merops
superciliosus persicus
philippinus philippinus
Both taken at same locality
Approximate boundary between species
Scale of Miles
70°
75°
80°
85°

Text-figure 1. Distribution of *Merops superciliosus persicus* and *Merops philippinus philippinus* during the breeding season in India, showing the narrow zone of overlap. The breeding range of *persicus* extends westward to Egypt; the breeding range of *philippinus* extends eastward to Malaya and Indo-China.

Triangles: *M. s. persicus*; squares: *M. p. philippinus*. Explanation of the numbered symbols is given in the text.

somewhat in different parts of the country and the movements of these bee-eaters are not well known, Mr. Sálim Ali has called to my attention the advisability of utilizing only those records of birds actually breeding. All of the records are taken from the literature. It will be noticed that there is very little overlap of breeding range; indeed, several authors have pointed out that where one form is found nesting the other is not known to breed.

The numbers refer to the positions on the map.

1. Bhavnagar, Kathiawar (Dharmakumarsinhji, 1947, *J. Bombay Nat. Hist. Soc.*, **46**: 723-724).
2. Khainju, Sukkur Dt., Sind (Baker, 1934, Nid. Bds. Indian Empire, **3**: 398).
3. Draklan, near Kashmor, Sind (Ticehurst, *Ibis*, 1923, p. 30).
4. Quetta, Baluchistan (Christison, *Ibis*, 1941, p. 544).
5. Bannu, N. W. Frontier Province (Magrath, 1908, *J. Bombay Nat. Hist. Soc.*, **18**: 685).
6. Peshawar, N. W. Frontier Province (Briggs and Osmaston, 1928, *J. Bombay Nat. Hist. Soc.*, **32**: 755).
7. Lahore, Punjab (Oates, 1890, Hume's Nests and Eggs of Indian Birds, **3**: 63-65).
8. Sultanapur, Punjab (ibid.).
9. Ferozepore, Punjab (Baker, 1934, op. cit., p. 397).
10. Delhi (Oates, loc. cit.).
11. Agra, United Provinces (ibid.).
12. Allahabad, United Provinces (ibid.).
13. Mirzapore, United Provinces (ibid.).
14. Hoshangabad, Central Province (ibid.).
15. Nagpur, Central Province (D'Abreau, 1935, *J. Bombay Nat. Hist. Soc.*, **38**: 105).
16. Raipur, Central Province (Oates, loc. cit.).
17. Waltair, Madras Prov. (Abdulali, 1945, *J. Bombay Nat. Hist. Soc.*, **45**: 342).
18. Rajahmundry, Madras Prov. (Neelakantan, 1948, *J. Bombay Nat. Hist. Soc.*, **47**: 741).
19. Coorg ('Feeding short-tailed juveniles'—Communication from Betts to Ali).
20. Gujarat (Littledale, 1886, *J. Bombay Nat. Hist. Soc.*, **1**: 196).

Ecology. *M. s. persicus* appears to be more tolerant of dry ground, and, at least in Iraq, may choose for a nesting site '. . . desert mounds or perfectly flat bare ground.' (Ticehurst, 1922, *J. Bombay Nat. Hist. Soc.*, **28**: 300), but in Afghanistan marshy areas are utilized (Whistler, 1944, *J. Bombay Nat. Hist. Soc.*, **44**: 291). For its nest hole *philippinus* prefers the banks of streams. In India, the limit of the range of *persicus* corresponds closely with the periphery of the dry area where the average annual rainfall is less than twenty inches.

Physiology. Besides being morphologically and ecologically distinct, these two forms differ physiologically. *M. s. persicus* makes a long southwestward migration in the autumn from its breeding grounds to its winter quarters in central and southern Africa. The post-nuptial molt is begun before migration (*vide infra*), but its progress is soon arrested; upon arrival on the winter range the birds undergo a complete molt. *M. p. philippinus* does not make such an extended migration and the post-nuptial molt immediately follows the breeding season. The direction of migration of this form is south-eastward to southern India, Malaya, and the East Indies.

The east-west migration of *persicus* from northwestern India across Iran and Iraq to Africa suggests a recent range expansion correlated with the progressive desiccation of northwestern India in the not too distant past. A secondary zone of contact would thus seem to have been established where the two forms meet and behave like good species. It remains for Indian ornithologists to determine whether occasional hybridization occurs in this zone or whether there is complete reproductive isolation as it now appears.

Merops superciliosus persicus Pallas

Luristan: Beshedalan, June 13, 1941, 1 ad. ♂; Burujird, July 22-23, 2 ad. ♀, 1 imm. ♀, September 25, 1 ad. ♂, 2 imm. ♂, October 7, 1 imm. ♂, October 17, 1942, 2 ad. ♂; Durud, October 15, 1941, 1 imm. ♂, 1 ad. ♀, October 21, 1 ad. ♀, 1 imm. ♀.

Khorasan: Nishapur, September 20, 1940, 1 ad. ♂, 1 ad. ♀.

Afghanistan: Baghlan, July 1, 1937, 1 ad. ♂; Taliqan, July 5, 1 ad. ♂; Chah i Ab, August 20-23, 1 ad. ♂, 1 imm. ♂, 1 ad. ♀, 2 imm. ♀; Khanabad, August 31, 1 imm. ♂; Aq Cha, Septemer 8, 1 ad. ♂.

Breeds from Kathiawar, Sind, Rajputana, Delhi, southern and western Punjab, west to Baluchistan, Afghanistan, Iran, Iraq, Syria, and Palestine to Egypt. In Egypt it is known chiefly as a migrant, but a few breeding colonies exist in the Nile delta (Meinertzhagen, 1930, Nicoll's Birds of Egypt, vol. 1, p. 327).

According to Sálim Ali (1945, Birds of Kutch, p. 72) neither species is found breeding in Kutch, but just to the south in Kathiawar *persicus* reaches its southernmost limit on the Indian peninsula. Baker (New Fauna Vol. IV p. 239) ascribes all the breeding birds of Punjab and Rajputana to *persicus*, but that is not entirely accurate. It will be seen from the distribution map that both *persicus* and *philippinus* breed at Delhi. The range of *persicus* probably extends throughout the lower, drier region of northwestern India as far east as Delhi where it meets *philippinus* in the western section of the United Provinces. The latter race extends northwest along the mountains in Kumaon and northwestern Punjab to southern Kashmir and Peshawar. In Rajputana, *persicus* has been found (though not breeding) as far south as the Aravalli Hills and from there westward to Sind.

Winters in southern and central Africa. On migration it passes regularly through Bombay (September-November).

There seems to be some tendency in this subspecies to begin the post-nuptial molt before migrating. In numerous adults taken between August and October there is evidence that some, but not all, of the body feathers are being replaced. The scapulars and the first three or four primaries are always renewed at this time. This type of molting behaviour is intermediate between that of *M. p. philippinus* and the complete molt into an eclipse plumage of *M. apiaster*, but in the latter none of the primaries are shed in the pre-migratory molt. Once on the wintering grounds there is a complete molt, by both adults and immatures, extending from November to January, with extreme dates October 1 (Gaboon) and March 29

(British East Africa). Adults and birds in first year plumage are indistinguishable after this molt.

Measurements (males only): Wing, 150, 153, 154, 157, 158. Tail, 89.5, 91, 91, 93, 94. Bill, 35, 35, 35, 36, 37.

Merops philippinus philippinus Linnaeus

Punjab: Kangra, Bhadwar, April 16, 1933, 1 ad. ♂.

United Provinces: Kumaon, Lechiwala, September 1, 1948, 1 imm. ♂.

Nepal: Hitaura, July 3-7, 1947, 1 ad. ♂, 3 ad. ♀, 2 imm. ♂, 1 imm. ♀, July 15-29, 1 ad. ♀, 1 unsexed ad., 1 imm. ♂, 3 imm. ♀.

Assam: Khasia Hills, Umran, April 15, 1949, 1 ad. ♀.

Bihar: Mohammadganj, August 20-29, 1947, 2 ad. ♂, 1 imm. ♂, 2 ad. ♀, 5 imm. ♀, 1 unsexed imm., September 5, 1 ad. ♀.

Central Province: Bheraghat, April 11-12, 1946, 1 ad. ♂, 1 ad. ♀, April 23, 1 ad. ♀, May 11-19, 2 ad. ♂, 1 ad. ♀.

Madras Province: Ellore, February 2, 1937, 1 ad. ♀; Kasargad, February 27, 1 ad. ♀.

Southern Bombay Province: Jagalbed, February 24-March 4, 1938, 2 ad. ♂, 3 ad. ♀, 1 unsexed ad.; Castle Rock, March 5, 1 ad. ♀; Supa, February 27, 2 ad. ♀.

Breeds from Northwest Frontier Province, northeastern Punjab and the United Provinces and east through Nepal, Bihar, and Assam to Burma, Yunnan, Kwantung, French Indo-China and northern Malaya. The southern limits of its range are obscure, but the southernmost breeding record seems to be that of Betts (communication to Ali) who found it feeding short-tailed young in Coorg. Stresemann (1940, *Journ. Ornith.*, **88**: 404) records this race breeding on Celebes.

The post-nuptial and post-juvenal molts may begin as early as July 4 (Nepal, female adult); some birds complete the molt as late as September 23 (Cachar, immature male). Young birds acquire the adult plumage through this molt. An immature female was taken on December 3 at Singapore, in worn plumage except for the new tertiaries and first six primaries, but such a late molt is exceptional.

Measurements: Wing, males, 131, 132, 132, 132, 132, 134, 135, 137; females, 121, 124, 124, 125, 126, 127, 127, 127, 127, 127, 127, 128, 128, 129, 131, 131. Tail, (outer rectrices), males, 87, 89, 91, 91, 91; females, 84, 86, 86, 87, 87, 88, 88, 89, 89, 89, 89, 90, 93. Bill, males, 31, 34, 34, 34, 34, 36, 36, 37; females, 31, 31, 31, 32, 32, 32, 32, 32.5, 32.5, 33, 33, 34, 34, 34, 35.

Merops orientalis

The range of this species extends from northern Africa across southern Asia to Annam. Nine subspecies are now recognized: two in Africa (*viridissimus*, *cleopatra*), three in Arabia (*cyanophrys*, *muscatensis*, *najdanus*), and four in the Iranian-Indo-Burmese area. The races of the last-named region are ill-defined, for they appear to comprise a single large variable population, the extremes of which are certainly separable, but which intergrade into each other through an intermediate group.

The easternmost subspecies, *birmanus*, occurs in Upper Burma, Yunnan, Siam and Indo-China. It differs from the nominate race in having the upper back, nape, and crown ferruginous; this area is only slightly tinged with rufous in *orientalis*. The latter race is found throughout most of India and is morphologically and geographically intermediate between *birmanus* and the subspecies resident in Sind, northwestern India, Baluchistan, and Iran. This western race, *beludschicus*, is the palest, with only a golden sheen on the green of the head.

Recently, Whistler (1944, *Spolia Zeylanica*, **23**: 223) separated the Ceylon population, describing the new race, *ceylonicus*, as having the bill longer and stouter than the bill of nominate *orientalis*, but approaching *birmanus* in the amount of rufous on the nape and crown.

Examination of seventy-six specimens of this bee-eater in the Koelz Collection, twenty-two specimens loaned by the Museum of Zoology, University of Michigan, and of a large series in the collection of the American Museum of Natural History, including the type of *beludschicus*, indicates that the racial differences reported in the literature are greatly exaggerated. The subspecific characters are slight and the nominate race itself occupies the unfavourable position of an intermediate population between the distinct extremes. However, if large enough series are compared it is frequently possible to correctly place the specimens.

The Assamese population is usually referred to *birmanus*, but I find the northern Cachar birds to be most like *orientalis*; although approximating the richer color of the eastern subspecies the ferruginous color is restricted more to the nape.

In the northwest, birds from the Kangra Valley in Punjab are *orientalis*, but just where the border between the nominate subspecies and *beludschicus* is to be drawn is not apparent from the present material. It is not improbable that *beludschicus* will be found to range into the dry lowlands of Rajputana and southern Punjab, as does *M. s. persicus*, but, from lack of other evidence, it seems best to consider Punjab birds as referable to *orientalis* and not, as Peters (1945, *op. cit.*, p. 237) has it, to *beludschicus*.

Comparison of Koelz specimens from Iran with a series including the type and a topotype of *beludschicus* fails to show any noticeable differences. Four males from Tomogaon on the Iranian Plateau are slightly larger. A female from Dirak, Baluchistan, in the Rothschild Collection, shows characters of both *orientalis* and *beludschicus*. All these, however, are best referred to *beludschicus*.

Two specimens from Ceylon in the Rothschild Collection, an adult female and an unsexed adult, both collected in December, agree with Whistler's description as regards the amount of rufous on the head and nape, but the bill, though scarcely stouter, is not longer. It seems unfortunate that this population was named, especially since the species has already been badly split, but I would want to see more material before synonymizing *ceylonicus* with *orientalis*.

Considering the three Indian mainland races as one population, it can be said that the easternmost birds are most rufous on the crown and nape; the intensity of color decreases towards the western limits of the range. In the west the throat is a pale blue, the blue showing a tendency to decrease and to be confined more to the cheeks toward the easterly limits of the range. In the west the underparts tend to be bluish-green and the upperparts pale green; the trend in an eastward direction is toward more yellow-green underparts and darker upperparts.

There are no appreciable size differences affording any basis for separating the four subspecies. The length of the central tail feathers was found to be quite variable within each race; only some of the variation could be ascribed to wear. Measurements are tabulated under the subspecies headings.

Males display a tendency to develop the central pair of rectrices more beyond the tip of the tail than do females.

Nesting takes place principally in April and May. The annual post-nuptial molt is complete and takes place from July to September. In birds of the year a complete post-juvenal molt occurs at about the same season.

Merops orientalis orientalis Latham

Northern Punjab: Kangra Valley, Bhadwar, April 9-10, 1933, 2 ad. ♀; Baijnath, May 19, 1 ad. ♀, May 26, 1936, 1 ad. ♂; Hissar, Sirsa, Jan. 20-Feb. 1, 1933, 5 ad. ♂, 2 ad. ♀; Panwali, March 8, 1 ad. ♀; Lahore, Feb. 9-17, 2 ad. ♂, 2 ad. ♀.

United Provinces: Gorakhpur, January 28, 1947, 1 ad. ♂; Nichlaul, February 9, 1 ad. ♂, February 12, 1 ad. ♀; Khada, February 26, 2 ad. ♂; Lechiwala, September 2, 1948, 1 ad. ♂; Lucknow, December 13, 1936, 1 ad. ♂, 2 ad. ♀.

Nepal: Simra, March 6, 1947, 1 unsexed ad.

Bihar: Raxaul, March 1, 1947, 1 ad. ♀; Garhwa Road, September 10-15, 3 ad. ♂, 3 ad. ♀.

Bengal: Dacca, January 12-13, 1937, 3 ad. ♂.

Surguja: Ramanujganj, September 27-October 2, 1947, 2 ad. ♂, 3 ad. ♀.

Central Province: Seven miles north of Jubbulpore, February 23-24, 1946, 1 ad. ♂, 1 ad. ♀; Bheraghat, March 11, 1 ad. ♂, 1 ad. ♀; Mandla, June 26, 1 imm. ♀; Belwani-Kisli, September 28, 1 ad. ♂.

Bastar: Kesarpal, March 29, 1949, 1 ad. ♂.

Mewar State: Udaipur, April 22, 1937, 1 ad. ♀.

Madras Province: Foot of Mahendra, January 26, 1937, 1 ad ♀; Rati, January 31, 1 ad. ♀; Sidhout, March 22, 1 ad. ♂; Salem, April 7, 1948, 1 ad. ♂.

Northern Bombay Province: Junagadh, Jamwala, January 31, 1939, 1 ad. ♀, February 11, 1 ad. ♂, 1 ad. ♀.

Southern Bombay Province: Londa, January 8, 19-20, 31, February 1-4, 13-15, 1938, 2 ad. ♂, 8 ad. ♀; Jagalbed, February 20-25, March 3, 1 ad. ♂, 2 ad. ♀; Supa, February 26, 1 ad. ♂.

Measurements: Wing, 20 males, 89-97 (93.6), 22 females, 89-95 (91.4). Tail, 19 males, 68-74 (71.2), 24 females, 65-74 (70.4). Bill, 25 males, 20-25 (23.2), 27 females, 19-26 (22.6).

Merops orientalis beludschicus Neumann

Iran: Iran: Tomogaon, February 3-4, 1940, 4 ad. ♂, 5 ad. ♀.

Kirman: Saadatabad, December 23, 1939, 1 ad. ♂.

Luristan: Isin, December 16-19, 1939, 3 ad. ♂, 2 ad. ♀; Bandar Abbas, December 21, 1 ad. ♂.

Fars: Borazjun, April 11, 1940, 1 ad. ♀.

India: Sind: Khinjar Lake, January 18, 1934, 1 ad. ♀, Jan. 23-Feb. 27, 3 ad. ♂, 3 ad. ♀; Karachi, December 3, 1939, 1 ad. ♀.

Measurements: (Tomogaon birds listed separately) Wing: males, 94, 94, 95, 96; females, 86, 90, 95, 95, 98; Tail: males, 69, 70, 71, 73, 73; females, 68, 69, 70, 70, 73; Bill: males, 22, 23, 24, 24, 24; females, 19, 21, 21, 23, 24. Tomogaon specimens: Wing: males, 95, 98, 99, 100; females, 91, 93, 94, 96, 99; Tail: males, 70, 73, 74, 77; females, 70, 72, 75, 78; Bill: males, 25, 25, 25, 26; females, 22, 22, 24, 25.

Nyctyornis athertoni athertoni (Jardine and Selby)

Nepal: Simra, March 4, 1947, 1 ad. ♂, 1 ad. ♀; Amlekhganj, March 9, 1 ad. ♂; Thankot, March 28, 1 ad. ♂; Hitaura, May 23, 1 unsexed ad., June 3, 1 imm. ♂, 1 imm. ♀, 1 unsexed imm., June 12-24, 3 ad. ♂.

United Provinces: Kumaon, Kathgodam, August 20, 1948, 1 ad. ♂; Lechiwala, September 1-2, October 28-30, 5 ad. ♂, 3 ad. ♀.

Bengal: Siliguri, December 29-30, 1936, 2 ad. ♀; Darjeeling District, Badamtam Forest, Rangit, December 24, 1 ad. ♂.

Assam: Khasia Hills, Nongpoh, May 3, 1949, 1 ad. ♂. June 22-28, 1 ad. ♂, 1 ad. ♀, 2 imm. ♂, 1 imm. ♀; Barni Hat, June 2, 1 ad. ♂, 1 ad. ♀, 1 imm. ♂, 2 imm. ♀, 1 unsexed imm.

Surguja: Ramanujganj, October 2, 1947, 1 ad. ♂.

Central Province: Kanha, August 13-30, 1946, 1 ad. ♂, 2 ad. ♀.

Southern Madras Province: Nilgiri Hills, Kunjapanai, February 20, 1937, 1 ad. ♂, 1 ad. ♀.

Southern Bombay Province: Jagalbed, February 18, 1938, 1 ad. ♂.

Nyctyornis athertoni is a forest bird of the Indo-Malayan region ranging from Travancore and Belgaum in southern India, the Central Provinces (but not yet reported from Chota Nagpur[1]), Nepal, and the United Provinces, to Assam, Vizagapatam Hills, Bengal, Burma, Siam, Indo-China, and Hainan. Its distribution in southern and central India is curious, the bird being not very common and existing for the most part in isolated ecological pockets. Sálim Ali (1948, *Gujarat Research Society, Monograph No. 2*) and Ripley (1949, *Evolution*, **3**: 150-159) believe that this species and many other Indian species exhibiting similar distributions spread south from the Himalayas or the Kaimur Ridge-Vindhyan chain of hills during periods of low temperature and high humidity, only to become isolated during following periods of higher temperatures and increasing desiccation. In effect, *N. athertoni* is a relict species in southern India.

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[1] Sálim Ali has recently collected specimens in Keonjhar and the Simlipal Hills (Mayurbhanj), Northern Orissa.—EDS.

TABLE 3

Measurements of Adults of *Nyctyornis athertoni*

Subspecies	N	Wing	Tail	Bill	Wing-Tail Index	Bill-Tail Index
Athertoni ...	12♂	135–143 (139·5)	127–140 (135·2)[a]	33–40 (36·5)	93·0–102·9 (96·1)	24·1–29·2 (27·0)
	13♀	130–138 (134·5)	127–136 (129·8)[b]	29–41 (34·9)	94·1–100·0 (96·7)	22·9–30·5 (27·1)
Brevicaudata[c] ...	5♂	132–138 (134·8)	122–130 (125·5)	37–39 (38·0)	92·4–94·9 (93·1)	29·2–31·7 (30·7)
	5♀	131–139 (133·9)	125–131·5 (127·7)	35–37 (35·4)	94·0–97·0 (95·4)	27·3–28·2 (27·7)

[a] $\sigma = 3{\cdot}9$.

[b] $\sigma = 2{\cdot}6$.

[c] Type measures : W. 132. T. 122 B. 37 (♂).

It was formerly thought that this bird has no subspecies but Koelz has since described a short-tailed race, *brevicaudata*, from Hainan (1939, *Proc. Biol. Soc. Washington*, **52**: 79). At that time there were available to him only six specimens of the nominate race and twelve of the Hainan population. The collection of a fairly large series of Indian material by Koelz affords an opportunity to review the status of this subspecies.

Measurements were made only on unworn and non-molting adults; included is the type and original series from which *brevicaudata* was described. The measurements are presented in Table 3.

The races are not too sharply defined. The females of nominate *athertoni* were found to have tail lengths concentrated among the lower values and it may be expected that further collecting will secure even shorter-tailed birds. Three of the five Hainan females and two of the five Hainan males overlap the mainland population in tail length. The averages of the wing-tail index and the tail-bill index indicate that the Hainan birds have a relatively shorter tail and, at least the males, have a longer bill relative to tail length.

Even though the differences are not striking it seems legitimate to recognize *N. a. brevicaudata*. All mainland birds are best included with the nominate race.

There is a single, post-nuptial, molt that is complete and takes place between May and October. The post-juvenal molt occurs at about the same time. Since the immature plumage is exactly like that of the adult, birds of the year are best distinguished by their somewhat smaller size, especially shorter bill, although not all short-billed birds are necessarily immatures.

TWO NEW SPECIES OF *ISCHAEMUM* FROM BOMBAY

BY

N. L. Bor

While working out a considerable collection of grasses from the Blatter Herbarium Bombay, two novelties in the genus *Ischaemum* were discovered and are described below.

Despite the fine work carried out on the grass flora of Bombay by Blatter and McCann, it is quite clear that much remains to be done.

Bombay contains a disproportionate number of interesting genera which are endemic, most of them monotypic, besides a large number of endemic species. Nearly all of these are annuals and come into flower at the end of the rains when plant hunting is not, in the ordinary course of events, popular.

Be that as it may, this time of the year is likely to be very fruitful and productive of new species. The neighbourhood of Castle Rock is one place that may be recommended as an excellent hunting ground. Other places in the province, however, may be expected to yield much of interest. *Ischaemum santapaui* was first collected at the end of 1949, but it turns out to be a very common grass with a fairly wide distribution—it was so common that it wasn't worth collecting.

Ischaemum bombaiense Bor, sp. nov. *I. robusto* Salisb. affinis sed ab eo spiculis multo majoribus, gluma superiore dorso nodulosa recedit.

Gramen annuum. *Culmi* usque 30 cm. alti, graciles, laeves glabrique, nodis ramosi. *Foliorum laminae* usque 12 cm. longae, 7 mm. latae, lineari-acuminatae, ad basin attenuatae, utrimque pilis e tuberculis ortis tectae, supra scabrae, brevissime petiolatae; petiolus dense albo-pilosus; *vaginae* laxissimae et a culmis solutae, laeves, striatae, marginibus scariosis et dorso apicem versus villosae vel dorso omnino pilis e tuberculis ortis tectae; vaginae superiores sine lamina; *ligula* scariosa, 2-3 mm. longa.

Racemi gemini; articuli rhacheos crassi, sectione triangulares, 7 mm. longi, 3 mm. apice lati, angulo exteriore villo-ciliati, denticulati. *Spicula sessilis*: *gluma inferior* 8 mm. longa, 3-3·5 mm. lata, oblongo-acuta, inferne coriacea, superne herbacea nervis multis gracilibus viridibus, superne carinata, inferne marginibus nodulosa, dorso convexo rugis transversalibus crassis ornata, sulfurea; *gluma superior* 8 mm. longa, explanata 5 mm. lata, navicularis, inferne dorso rotundata, superne valde carinata, 3-nervis, dorso inferne 2-3 nodulis ornata, carina et marginibus apicem versus scaberrima. *Anthoecium inferius* ♂; *lemma* oblongo-ellipticum, acutum, 8 mm. longum, hyalinum; *palea* ei similis sed minor; *stamina* 3; *antherae* 3 mm. longae. *Anthoecium superius* ⚥; *lemma* 6 mm. longum, ad ½ fissum, aristam geniculatam e fissura emittens; *palea* squama hyalina 6 mm. longa; *stamina* 3; *antherae* 2·75 mm. longae; *styli* 2; *stigmata* plumosa, purpurea; *arista* 20 mm. longa; *columna* torta, brunnea, 8 mm. longa. *Spicula pedicellata*: pedicellus sectione triangularis, 1·5 mm. longus, altero margine villo-ciliatus; *gluma inferior* glumae inferiori spiculae sessilis similis, sed altero margine late alata, 7·5 mm. longa, 3 mm. lata; *gluma* superior navicularis, 7 mm. longa, basin versus 2-3 nodulis instructa; nervi superne anastomosantes; *anthoecium inferius* vacuum; *lemma paleaque* elliptico-lanceolata, acuta, hyalina. *Anthoecium superius* ♀; *lemma paleaque* eis anthoecii inferioris similes.

Ischaemum bombaiense Bor, sp. nov. An annual grass. Culms up to 30 cm. tall, slender, smooth and glabrous, branching at the nodes. *Leaf-blades* up to 12 cm. long, 7 mm. wide, linear-acuminate, narrowed to the base, covered on both surfaces with bulbous-based hairs, smooth on the margins below, scabrid above, very shortly petiolate; petiole covered with dense white hairs; sheaths very loose and slipping from the culms, smooth, striate, villous on the scarious margins and near the top, or covered with bulbous-based hairs all over, those near the top of the culm without leaves or only with rudimentary leaves; *ligules* scarious, 2-3 mm. long.

Racemes in pairs seated at the tip of a stout peduncle, the lower two joints of the rhachis being confluent. *Joints* of the rhachis very stout, triangular in section, 7 mm. long, about 3 mm. across at the top, villous-ciliate on the exterior angle, toothed at the upper articulation. *Sessile spikelets*: *lower glume* 8 mm. long, 3 to 3·5 mm. wide, oblong-acute in shape, crustaceous-coriaceous in the lower half, herbaceous above with numerous very fine, green nerves, rugose in the lower half with 3-4 very stout ridges, bright yellow in colour, keeled above, nodular on the margins below, scabrid on the keels above, for the rest smooth and glabrous; *upper glume* 8 mm. long, 5 mm. wide when flattened, boat-shaped, rounded on the back below, strongly keeled above, 3-nerved, the central nerve dividing half-way up at the point of junction of the awn with the upper lemma and afterwards nerves anastomosing above, with 2 or 3 nodules on the dorsal surface near the base, scabrid on the keel and very scabrid on the two margins above. *Lower floret* ♂; *lemma* oblong-elliptic, acute, 8 mm. long, hyaline; *palea* similar but smaller; stamens 3; anthers 3 mm. long. *Upper floret* ⚥; lemma 6 mm. long, cleft half-way down and armed with a geniculate awn in the cleft; *palea* a hyaline scale 6 mm. long; *stamens* 3; anthers 2·75 mm. long; *styles* 2; *stigmas* plumose, purple: *awn* kneed, 20 mm. long; *column* brown, 8 mm. long, twisted. *Pedicelled spikelet*: pedicel triangular in section, very stout, 1·5 mm. long, villous-ciliate on the outer margin; lower glume very similar to the lower glume of the sessile spikelets, but with a broad wing on one margin, 7·5 mm. long, 3 mm. wide; upper glume boat-shaped, 7 mm. long, with 2-3 prominent nodules on the dorsal surface at the base, nerves anastomosing above. *Lower floret* empty; *lemma* and *palea* elliptic-anceolate, acute, hyaline. *Upper floret* ♀; *lemma* and *palea* hyaline, similar to those of the lower floret.

INDIA: Bombay, Khandala. Tata's Lake, Blatter 9904. (Typus in Herb. Kew. et in Herb. Blatt., Bombay).

This is a most remarkable species. At first sight it might be taken for *Ischaemum rugosum* Salisb. were it not for the very large

spikelets. A further remarkable and unique feature in the genus is the presence of nodules on the upper glume of both the sessile and pedicelled spikelets. This grass should be sought for again and should not be very difficult to find.

Ischaemum santapaui Bor, sp. nov. *I. imbricato* affinis sed ab eo habitu annuo, culmis ramosis, spiculis minoribus recedit.

Gramen annuum, in oryzetis incolum, dense caespitosum. *Culmi* usque 2 mm. alti, in paludibus geniculato-ascendentes, e nodis inferioribus radices aereas demum in solum penetrantes emittentes, subrobusti, teretes, multinodes, laeves glabrique, purpurascentes, nodis ramosissimi; e nodo rami 7-8, 1-nodes, superne vaginam sine lamina gerentes, ex vagina 1-2 racemos emittentes, nodis pilosi. *Foliorum laminae* lineari-acutae, usque 15 cm. longae, 10 mm. latae, basi rotundatae vel vix cordatae, utrimque glabrae scaberrimaeque; *vaginae* laxissimae, glabrae laevesque, striatae, e culmis solutae; *ligula* lacerata, membranacea, 2-3 mm. longa.

Racemi numerosi, gemini, divergentes, usque 5-6 cm. longi; rhachis fragilis; spiculae ad quemvis rhacheos nodum binae; articuli 3 mm. longi, triangulares, altero margine pilosi. *Spicula sessilis*: *gluma inferior* (cum callo 0·5 mm. longo) 4·5 mm. longa, 1·75 mm. lata, dorso plana, 10-11-nervis, oblonga, acuta, inferne chartacea, superne herbacea nervis multis viridibus, superne bicarinata, carinis scabra, inferne marginibus rotundata, marginibus per totum decursum anguste inflexis; *gluma superior* 4·5 mm. longa, navicularis, superne carinata, inferne dorso rotundata, dorso prope carinam scabra, membranaceo-chartacea, apice acuta, mucronata. *Anthoecium inferius* ♂; *lemma* hyalinum, lanceolatum, acutum, 3·75-4·25 mm. longum, 1·25 mm. latum; *palea* circiter 3 mm. longa, sed angustior; *stamina* 3; *antherae* 1·5 mm. longae. *Anthoecium superius* ⚥: *lemma* latiusculum, 3·5 mm. longum, ad ½ fissum, lobis acutis, ex fissura aristam geniculatam emittens; *palea* squama triangularis, hyalina; *stamina* 3; *antherae* 2·5 mm. longae; *styli* 2; *stigmata* plumosa; *lodiculae* 2, truncato-cuneatae; *arista* 15 mm. longa; *columna* brunnea, torta, 6 mm. longa. *Spicula pedicellata*: *pedicellus* 2 mm. longus, 2-angulatus, angulis ciliatus; *glumae* vestigiales, herbaceae, multinerves.

Ischaemum santapaui Bor, sp. nov. An annual grass growing in ricefields and swamps, densely caespitose. Culms up to 2 mm. tall, in wet places decumbent at the base, with many roots and numerous stilt-roots from the lower nodes, many-noded, smooth and glabrous (purplish in colour), much branched at the nodes; branches slender, 7-8 from each node, 1-noded, bearing at the tip, in a sheath with reduced blade, a single or a pair of racemes, white, hairy at the nodes. *Leaf-blades* linear-acute, up to 15 cm. long, 10 mm. wide, rounded or shallowly cordate at the base, glabrous on the upper and under surfaces, coarsely scabrid on both surfaces; sheaths very loose, smooth and glabrous, striate, slipping from the culms; *ligule* lacerate, membranous, 2-3 mm. long.

Inflorescences very numerous on each plant; racemes binate at the tips of the glabrous peduncles, divergent, up to 5-6 cm. long; rhachis fragile, bearing at each node a sessile and a pedicelled spikelet;

joints of the rhachis 3 mm. long, 3-angled, long hairy on one angle, smooth and glabrous on the other two, with an oblique articulation at the tip. *Sessile spikelet*: *lower glume* (with a callus 0·5 mm. long) 4·5 mm. long, 1·75 mm. wide, 10-11-nerved, oblong, flat on the back, tapering to an acute tip, chartaceous below, herbaceous above with many green nerves, 2-keeled above with scabrid keels, rounded on the margins below with margins narrowly incurved from base to apex; *upper glume* 4·5 mm. long, boat-shaped, firmly keeled in the upper half, rounded on the back below, scabrid on the back near the keel, membranaceous-chartaceous in texture, acute at the tip, mucronate. *Lower floret* ♂; *lemma* hyaline, lanceolate-acute, 3·75-4·25 mm. long, 1·25 mm. wide; *palea* about 3 mm. long but narrower; *stamens* 3; *anthers* 1·5 mm. long. *Upper floret* ⚥; *lemma* rather narrow, 3·5 mm. long, cleft half-way down, with a geniculate awn in the cleft; *palea* a triangular scale, 3 mm. long; *stamens* 3; *anthers* 2·5 mm. long; *styles* 2; *stigmas* plumose; *lodicules* 2, truncate, cuneate; *awn* with an elbow at its point of juncture to the lemma, 15 mm. long; *column* brown, twisted, 6 mm. long; *bristle* scabrid. *Pedicelled spikelet*, rudimentary, consisting of rudimentary glumes, seated on top of a short pedicel; *pedicel* 2 mm. long, 2-angled, ciliate on the angles; rudimentary *glume* often a small scale but towards base of the raceme up to 2 mm. long, herbaceous and many-nerved.

INDIA: Bombay Presidency, Karjat, G.I.P. Rly. Riversides. 11-12-1949, H. *Santapau* 9665. (Typus in Herb. Kew. et in Herb. Blatter, Bombay). Father Santapau states in litt. "The plant is very common all over Karjat in ricefields (after the harvest), along hedges, and from Karjat upwards to Khandala along the railway line, some of the specimens being from Khandala itself; before reaching Karjat it is also found along the railway line in fairly good abundance. The grass grows in dense tufts or clumps, the number of culms per clump being up to 50, in height up to a little over 1 m. generally, occasionally to nearly 2 m.; in the lower part of the culms the plant throws out adventitious roots from several nodes. The branching or multiple proliferation of the nodes is very noticeable. In ricefields the plant occasionally appeared prostrate at the lower nodes, then erect for the rest."

LIFE-HISTORY AND BIONOMICS OF THE CAT FLEA, *CTENOCEPHALIDES FELIS* BOUCHÉ.[1]

BY

K. R. KARANDIKAR AND D. M. MUNSHI

(*With six text figures*)

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LIFE-HISTORY

Fleas are holometabolous insects. Eggs are laid generally in such places where the host animal rests during the night and where the larvae on hatching can obtain their food without much difficulty. Some of the locations selected for egg laying are dirty corners, under the carpets, in straw mattings, cracks and crevices in the floor, unclean chicken houses containing dried excrement, feathers, straw, etc. *Ctenocephalides felis* oviposits in the fur-covering of its host (cat) and also near the breeding places of the same animal. Plenty of eggs were obtained from a blanket which formed the bed of a kitten. Observations on the mode of oviposition were made with the help of the *draw tube technique* described below.

A glass tubing was drawn out to form a fine narrow pipette with a lumen which would hold a number of fleas in a single row. The end of the pipette was closed, and flea specimens were introduced into it and blown with mouth towards the closed narrow passage. The movements of the fleas thus enclosed in the narrow passage in a single row were observed with the help of a low power microscope.

Egg

Just prior to actual egg-laying, the flea wriggles about restlessly and shows very rapid movements of the legs and the mouth parts. Suddenly after this a little quantity of fluid excretion is ejected with a considerable force through its genital aperture, and immediately afterwards, an egg is launched out and deposited into the fluid. The process is repeated and more eggs are deposited in the same manner. The flea under observation was found to deposit three eggs in quick succession.

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[1] This paper forms a part of the thesis submitted by the junior author for the M.Sc. degree to the University of Bombay.

A female *Xenopsylla cheopis* is reported (14) to deposit from 2 to 6 or even more eggs at a time, and is capable of laying 300 to 400 eggs during its life-time. In the case of *C. felis* a female laid over 800 eggs during its life-time.

Eggs of *C. felis* are just visible to the naked eye, their average size being about 300 microns (Fig. 5). They are broadly oval in shape and glistening white in colour. The surface of a freshly laid egg is perfectly smooth, but when dry, it shows a faint reticulum spread all over in a discontinuous way. Unlike the eggs of other fleas which become dull and darkish with age, those of the cat-flea remain relatively unaltered in colour, except that they become a little opaque.

Minute micropylar openings which provide passage to the spermatozoa during fertilization, are situated at each pole of the egg and arranged in circular rows. There are 35 to 55 such openings at the anterior pole of the egg of *C.felis*, and 20 to 30 at its posterior pole.

Larva

The eggs hatch after 2 to 4 days into a tiny worm-like apodous larva which moves about actively and away from light by means of bristles which encircle its body segments (Fig. 1). When full grown, it measures about 4 mm. in length. It has a distinct head, three thoracic segments and ten abdominal segments. The midportion of the body covering the seventh and eighth segments is the broadest. The body tapers towards the anterior and posterior extremities, the head and the terminal abdominal segment being the smallest. The latter bears a pair of stout, blunt, hooked, chitinous processes called the anal struts. The head which is of the prognathus type is more chitinized and darker in colour than the body-segments. It bears a pair of slender cylindrical antennae. The ocelli are absent. The mouth parts which are of the biting-crushing type, consist of the labrum, a pair of mandibles, a pair of maxillae and the labium.

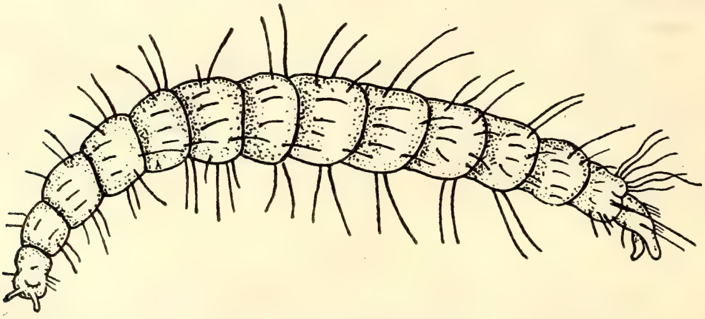

Fig. 1. Larva of *C. felis*.

The larva, unlike the imago, is not parasitic in its feeding habits. It feeds on the organic debris found on the body of the host. An examination of the contents of the larval stomach reveals the presence of blood and blood-pigments. Obviously their source lies in the organic debris which is usually formed of the faecal matter of the adult fleas containing half-digested blood. Occasionally the larvae occur on the hind region of the body and in the dirty pelt of the host. Larvae of other species of fleas are also found at times on the body of nestling birds and also on human beings with unclean habits. Here they probably feed on the organic material present on the skin of the host which at times contains blood defaecated by the parent flea. The presence of this blood can be demonstrated in the form of minute dark-coloured particles on the fur or feathers of such animal hosts.

The larva passes through three consecutive instars. The length of the larval life is not definite and generally varies according to the temperature and humidity conditions of its surroundings. Generally speaking the larval life extends over a period of 9 to 10 days. Towards the end of this stage, the larva surrounds itself with a silken cocoon (Fig. 6) spun from its own salivary secretion. Pieces of debris are incorporated in the walls of the cocoon with the result that it resembles its surroundings so closely that it is very difficult to spot it out. Often several cocoons adhere together to form masses which then become visible to the naked eye. When the cocoon is completed, the enclosed larva moults into the pupal stage.

Pupa

The pupa resembles the adult. In a full-grown pupa which is whitish in colour, the segmentation of the exoskeleton can be clearly seen (Fig. 2). The head is bent ventrally and the palps and the legs lie folded and well-pressed against the ventral surface of the body. The duration of the pupal stage is from 7 to 10 days, after which the pupa moults into the *imago* (Fig. 4). Thus the whole life-cycle of the flea is completed within a period of about three weeks.

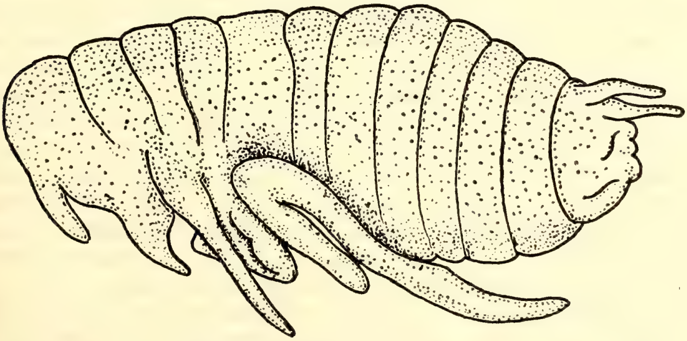

Fig. 2. Pupa of *C. felis.*

The life-cycle period may be shorter in the case of tropical fleas living under optimal conditions, with a temperature of 23°C. and humidity from 80% to 90%. Observations on the development of the dog flea (*Ctenocephalides canis*), according to Russel (17), indicate the duration of the different stages as follows:—egg stage—2 days; larval stage—6 days; pupal stage—8 days; total period of the life-cycle—16 days. However, under extremely abnormal conditions, such as low temperature and scarcity of food, the life-cycle of the flea from the egg to the adult may take a much longer period, which, as reported by Jordan (18), may in some cases extend from 18 to 20 months.

Very often the imago may remain quiescent in the cocoon for a very long time before it emerges from it to lead a free active life. Waterston and Jordan (25) state that a mechanical stimulus from outside, however slight, is required for the resting imago to break through its cocoon, and in the absence of that stimulus, the emergence is very often delayed. They also state that the required stimulus is usually supplied by the host itself by brushing against the resting cocoons which thus become activated, and emergence follows.

More striking is the behaviour of certain fleas such as *Ceratophyllus styx*, which leaves the cocoon before the arrival of its emigrant host, the sand martin, and instinctively waits for it near the entrance of its burrow. This probably accounts for the sporadic outbreak of fleas after long intervals.

After emerging from their cocoons fleas can live without food for a considerable period of time. When sexually mature, copulation takes place and the cycle starts over again.

BIONOMICS

Hosts of Fleas

The normal food of the fleas is the blood which they obtain from the hosts on which they live a parasitic life. As a general rule, a flea restricts itself to its specific or true host, but in the absence of such a host, it will readily attack and feed on the blood of other animals which may, therefore, be called the casual or accidental host. The latter may belong to allied species or even to widely separated ones. Thus the common cat-flea (*Ctenocephalides felis*) is also found on dogs and may even attack man. Rat fleas feed on mice and even moles. The common rat-flea (*Xenopsylla cheopis*) readily feeds on the blood of man in the absence of its normal host. The *Pulex irritans*, which is specific of man, also feeds on blood of the dog in North China and visits man only when the dog is not available. In Europe *Pulex irritans* lives normally on man. The dog-flea (*Ctenocephalides canis*) is a common ectoparasite of the jackal and is not often seen on the dog. It may even be found on cats. Many animals exchange fleas with one another due to their living close together. That is why the bird fleas are found on mammals or even on bats. Beasts of prey are infested with fleas from the victims on which they prey. Thus rabbit fleas are found at times on wild cats. Russel (17) has stated that a German naturalist collected 2,036 fleas from theatres, concert halls, ball rooms, schools and barracks in the great Duchy of Baden and found that 50% of them were dog-fleas. In zoological gardens cat-fleas are generally numerous in most cages.

Probably more species of fleas have been obtained from Insectivora and Rodents than from other Orders of Mammals taken together. It may, however, be mentioned here that Ungulates and monkeys are the only mammals generally free from the flea trouble. Russel (17) suggests that Ungulates are immune to fleas, due to the fact that their young ones always follow their mother from the time of their birth, instead of leading a stationary, helpless life in their shelters. It has also been observed that the relationship between a flea and its specific host is often characterised by individual preferences. Thus the human flea will readily feed on the blood of a particular person and reject that of another although belonging to the same species.

Feeding Habits

Some fleas may remain attached to the body of their specific host nearly throughout their life and thus prove to be highly parasitic in habit, while others may act only as temporary parasites. Female fleas belonging to the family *Hectopsyllides* (*Sarcopsyllides*) fix themselves to the body of their host and remain attached in one position for a greater part of their life. The 'Jigger' (*Tunga penetrans*) may be mentioned as an example of this habit. The females may even bore through the skin and oviposit subcutaneously. Other species bite occasionally, taking short feeds, and still others may take a long feed and then hop away from the body of the host to return once more after a lapse of time. Many species of fleas do not suck blood more than once in their life. As a general rule, fleas are temporary parasites. When the temperature is high, the process of digestion takes place rapidly in fleas as in other insects. Thus the number of feeds is closely correlated with the rapidity of digestion which, in its turn, is governed by temperature conditions.

It is rather a remarkable fact to note that some fleas, under conditions of starvation, will resort to taking in liquid food other than blood. Thus a starved flea will suck a drop of water or even insert its mouth parts into the skin of a caterpillar and suck its fluid. Damph (6) introduced a number of common bird fleas (*Ceratophyllus gallinae*) of both sexes on the body of a hairy caterpillar and observed that the fleas immediately started sucking the body fluid of these insect larvae. He also observed that a naked hairless caterpillar was not, however, attacked by such fleas. Russel (17) has mentioned that the larvae of *Pulex irritans* prey on caterpillars and feed on their juices. The common belief that the capacity of oviposition of a flea depends upon adequate feeding prior to that process, has been refuted by Jordan (18) who states that a freshly emerged flea can start laying eggs even before leading any parasitic existence, since enough nutritional matter is stored by the larva and carried over to the adult stage to enable a certain number of eggs to get ripened. Several successive generations have been observed to have been produced in this way. This fact easily accounts for the excessively large number of fleas found sometimes in uninhabited huts and other locations such as grain storage, etc., where the normal food is not available.

Mode of Feeding

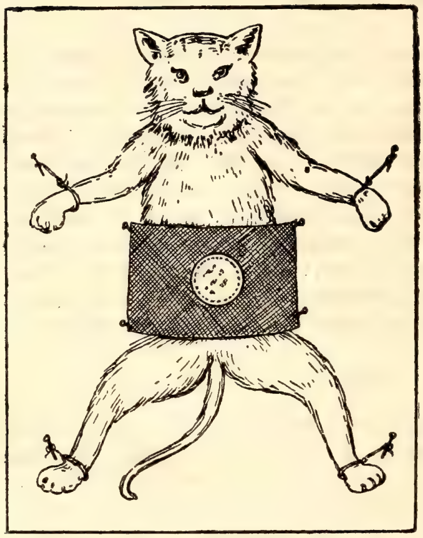

Fig. 3. Demonstrating the mode of feeding.

Observations on this point were made with the following technique. A kitten was first laid on its back on a dissection wooden board and its limbs were tied by strings on to nails fixed to the corners of the board (Fig. 3). Its head was then adjusted in position by means of a leather strap fitted across its neck. Its belly was shaved so as to make the skin clean and bare. A square piece of clean white flannel with a median circular hole of about an inch in diameter was spread and tied to the belly. Another piece of soft wire gauze with a close meshing and of the same size as the flannel piece was taken and had a median circular aperture of the same size cut into it. The wire gauze was then spread over the flannel piece in such a way that both the apertures coincided with each other. The gauze was then fixed to the board and a flea starved for about a week, was introduced on the portion of the belly exposed through the apertures. A watch glass was immediately placed over the aperture in order to close it and trap the flea within the circular area. Movements of the flea were then observed with the help of a binocular dissecting microscope.

Before the stylet-like piercing mouth parts were inserted into the skin of the host, a flea was seen wandering about on the surface of the skin, as if for the purpose of exploration, making occasional punctures here and there. When an appropriate spot was discovered, it immediately took up a tilted position. The epipharyngeal and the mandibular stylets were then thrust into the skin, while the furcate labium was bent outwards, the palps forming an angle with the submentum. The forelegs spread outwards and thus balance the posterior region of the body high above the surface of the skin. So long as it was not disturbed, it remained absolutely glued to the spot. In this position it could be examined from all sides with the help of a powerful lens or a telemicroscope. Within two or three minutes one could see its abdomen gorged with red blood. Careful observations also revealed the up-and-down movements of the mandibles and the passage of blood through the pharynx into the pulsating mid-gut.

Locomotion and Means of Distribution

The normal mode of locomotion in fleas is by jumping from place to place. They can also glide their way easily through fluffy objects, such as fur, cotton, wool, flannel, etc. Being habituated to this type of locomotion in the furry coats of mammals, birds and such other hosts, certain structural adaptations have been developed by them. They have a bilaterally compressed body covered with spines and bristles all of which are backwardly directed. In the case of the combed fleas like *Ctenocephalides*, the spines of the comb are also similarly directed. The antennae being delicate and sensitive, are lodged within the antennal grooves, the eyes are protected by the '*ocular*' and '*frontal*' bristles. If disturbed, they often sham death and rest with their legs tucked in tightly to the body, in which condition they may even be blown about. With the help of their powerful legs they jump over long distances. Patton (14) states that the longest jump a flea can take, measures over 33 cm., and the highest jump taken by it reaches a height of about 19·5 cm. When off the host, the fleas remain confined to the ground and cannot distribute themselves far and wide like winged insects. But they are carried from place to place through the agency of their hosts. Transport, especially sea-transport, helps a good deal in the distribution of fleas from port to port. Also the eggs which are frequently laid on the host are scattered about when the animal goes to its resting place.

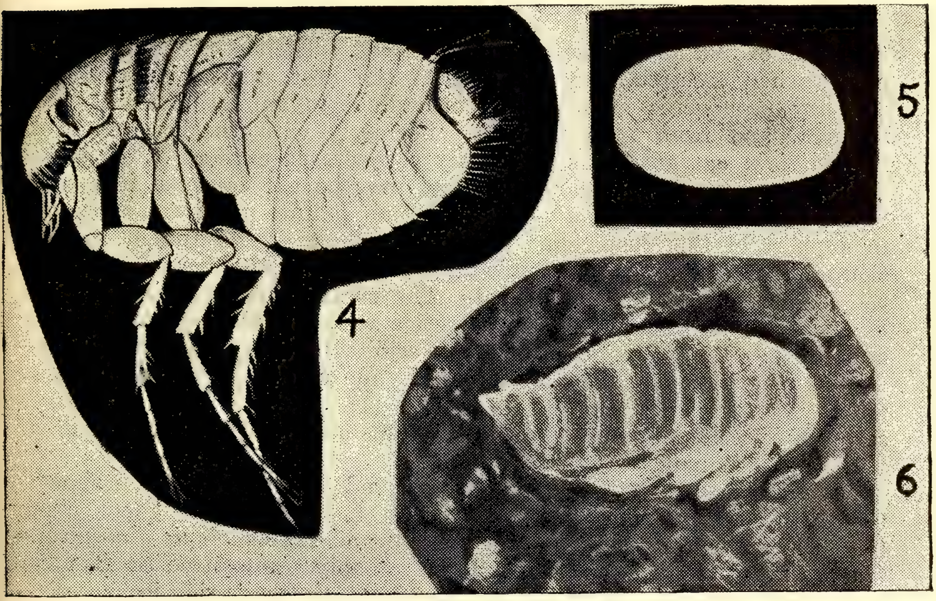

Fig. 4. Adult of *C. felis.*
Fig. 5. Egg of *C. felis.*
Fig. 6. Pupa exposed by cutting open the cocoon.

Longevity

Observations made by Nicolle (12) on *Nosopsylla faciatus* indicate that the average length of life of the flea is from 6 to 8 days under ordinary temperatures. Experimentally however fleas have been kept alive for several months. Bacot (2, 3) for instance, had kept *Pulex* *irritans* in the living condition for 513 days. *Xenopsylla cheopis* lived for 162 days [Webster and Chitre as quoted by Patton (14)]. Strickland (21) kept fleas living as long as 17 months without feeding them at all during this period. Nicolle (12) states that under certain conditions the larvae and pupae of fleas remain unmetamorphosed for months and months. Jordan (18) also mentions that the pupa may lie quiescent within its cocoon for an indefinitely long period until it receives the requisite mechanical stimulus for its emergence. As regards *C. felis*, it was observed that the flea could be kept alive for over three months under experimental conditions.

Fleas as Vectors of Diseases

Many of human diseases are due to fleas. Their stylet-like mouthparts, when inserted into the skin of the host, render them liable to carry pathogenic organisms from animal to animal, from animal to man, and from man to man. Formerly with the exception of *Diphylidium canium*, fleas were only suspects as carriers of diseases. There was enough suspicion that fleas may be the cause of *relapsing fever*, *typhus fever*, and *kala-azar*. But no definite proof was available in support of this suspicion, until the findings of the Indian Plague Commission (1), in connection with their role in the transmission of the plague germs, were published. The common rat-flea (*Xenopsylla cheopis*) is now known to be an effective vector of the bubonic plague and the murine (endemic) typhus. Verjbitski (24) successfully transmitted the plague bacilli from rat to rat by means of the *Ctenocephalides felis*. The Indian Plague Commission (1), during their exhaustive series of experiments, succeeded in the transmission of the same bacillus with the human flea (*Pulex irritans*).

Ctenocephalides canis, *Pulex irritans* and *C. felis* have been shown to be the intermediate hosts of certain helminths that affect man (e.g. the tapeworms *Diphylidium canium* and *Hymenolepis diminuta*). *Haemorrhagic septicaemia* of cattle is probably transmitted by *C. felis* in tropical countries (7). The digestive tract of fleas is rich in bacterial flora and protozoal fauna. That the flea is a potential reservoir of protozoal infection, has been shown by various workers prominent amongst whom have been Balfour, Cowdry, Korke, Laveran, Minchin, Noller, Patton, Ross, Splendore, Swingle, Tyzzer, Wenyon, Yamasaki and others. As a result of the laborious work done by these workers in different parts of the world, remarkable facts about protozoal and spirochaetal infection by fleas have been revealed. Recent researches in insect microbiology have shown that *C. felis* has also been found to be a carrier of some unnamed species of *Crithidia* (20) and *Rickettsia ctenocephali* (20).

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THE LOWER SIND VALLEY, AND SOME FURTHER OBSERVATIONS ON BIRD PHOTOGRAPHY

BY

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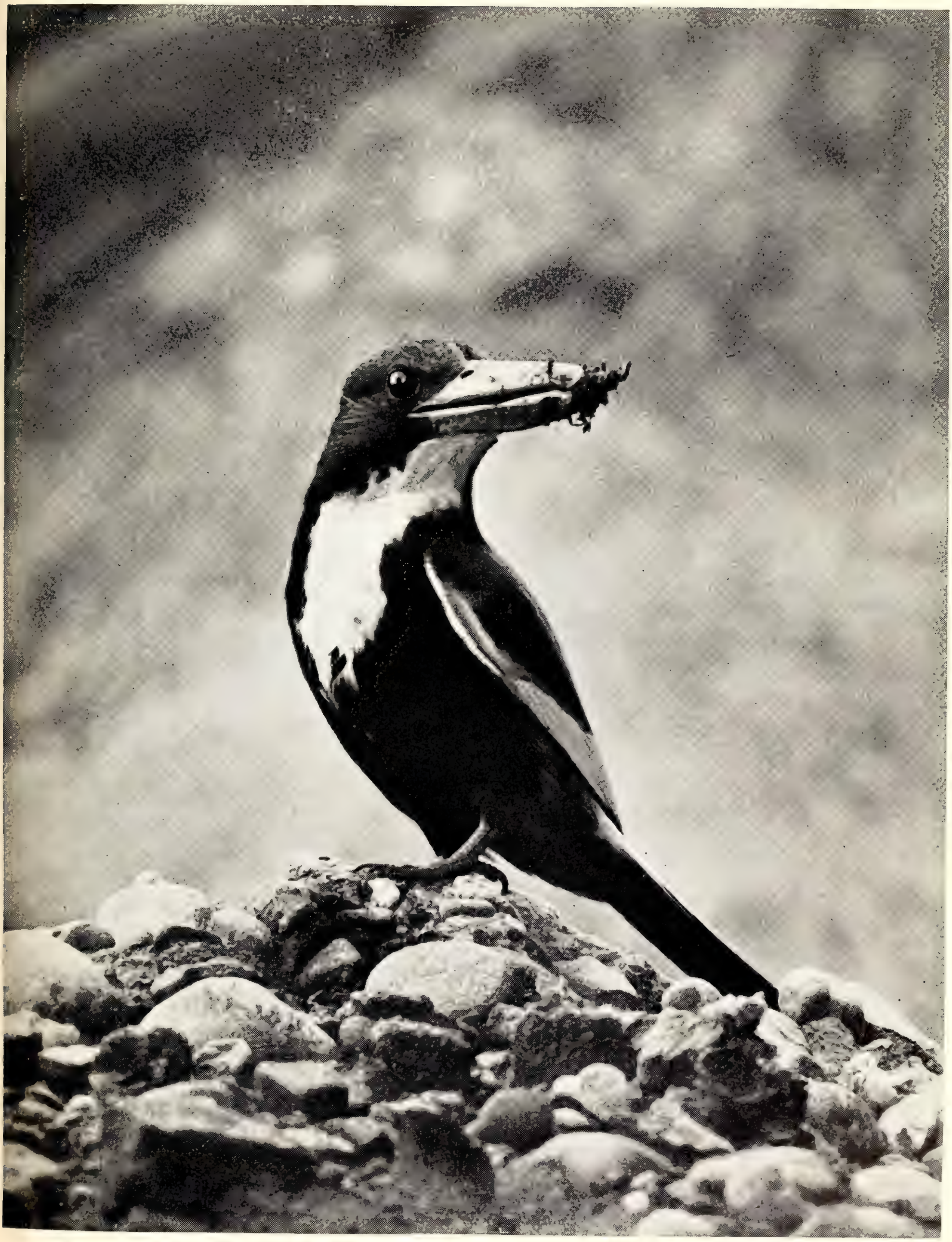
(*With* 4 *plates*)

In the spring of 1943 I had an enforced spell in hospital. The hackneyed saying that it is an ill wind that blows no one any good operated well to my advantage on that occasion. For, after the surgical specialist had removed what he called a foreign body, a considerate Medical Board granted me a month's sick leave to regain the use of my leg. I joined my wife in Murree, where I soon found I was capable of getting about fairly well on even ground. That being so, we decided to make at once for the Vale of Kashmir to see what transpired in June between Ganderbal and Kangan in the lower reaches of the Sind Valley.

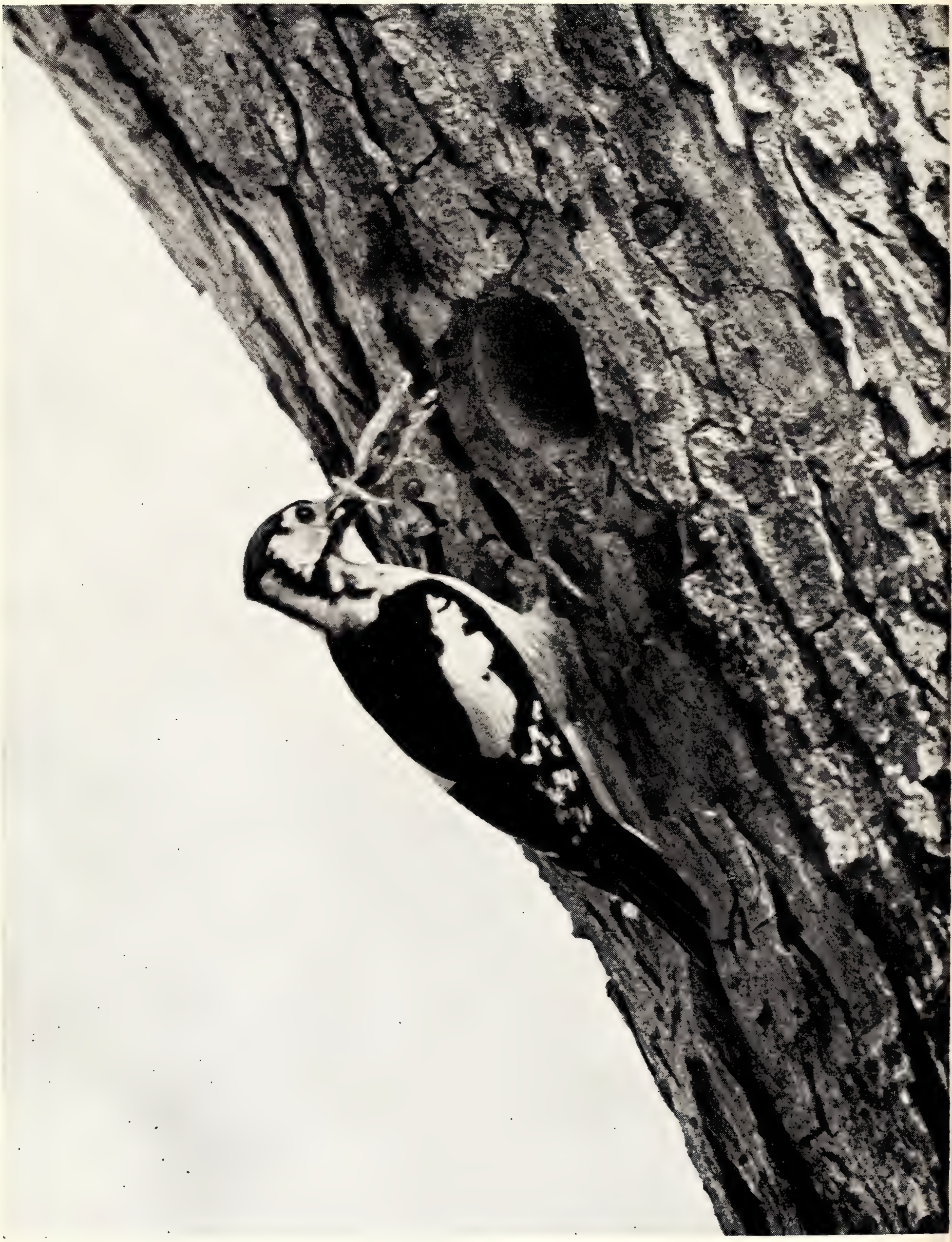
In Srinagar I gleaned some useful information from Bob Lowther, whom I contacted in the Chenar Bagh. He had just come in from Shalabug after working around Ganderbal in the hopes of netting photographs of the elusive Ibisbill. I fear the nesting of that intriguing bird in the Lower Sind has in all probability now been brought to an end through the reclamation of the larger islands and the avarice of certain unscrupulous egg-shikaris. Whether the present unsettled state of the country will re-act to the advantage or detriment of the species, and allow it to rehabilitate itself in the area, it is impossible to say, but I live in hopes.

The late Colonel 'Bingie' Phillips, whose recent death in Mombasa we all mourn, is, I believe, the only bird-photographer in India to have tried successful conclusions with that bird of superlative interest. He had a considerable amount to say about it in Vol. 45, pp. 347-52. It lays its eggs in April, so his nest of 4 eggs, found by him on the 10th of that month, was by now finished with, and Lowther reported seeing both birds on the 4th May still in the vicinity of the nest but unaccompanied by their young. Some disaster appeared to have befallen the family. A mile or so further upstream another pair were accompanied by 4 small young, so at least one couple still appeared to have a chance of bringing a brood to maturity.

I saw what must have been the abandoned nest of Phillips's birds. It was a flat mosaic of small stones covering a circle of about 8 inches diameter amongst the coarser shingle tailing off a small island. It was placed on the highest part of the ridge to be above normal flood level. A point to which I would draw attention is the even curve of the bill in the living bird portrayed in Colonel Phillips's photographs. Is it possible that the bill in museum specimens assumes the more peculiar shape shown in the woodcut in the *Fauna* through shrinkage during the process of drying?



White-breasted Kingfisher with giant mole-cricket for young.



Kashmir Pied Woodpecker at nest-hole.

It is not really of this bird that I wish to write, for I could hardly expect to get even belated information about it of which I could make use. It was the news brought by L regarding a nesting pair of White-breasted Kingfishers which most intrigued me. Previously I had only seen this bird with any regularity in the Jhelum Valley as far up as Garhi, and in the Kishenganga at the lower end of the Tithwal Gorge, though once, many years ago, I heard a bird calling near the Nasim Bagh. But here it was, actually nesting in a quarry-face at Ganderbal. L noticed the nest on 12th May when he saw both birds leave the tunnel. At that time they seemed to be feeding on small fry and frogs. His shikari recognised the bird and testified to having once seen a nest in the Vale, but this find of Lowther's is, I believe, the first authentic record of this Kingfisher's nesting so far into the Himalayas at this point. It appears to be extending its range, for later on Colonel Phillips wrote to me that he had been coming across it in the Vale at all seasons of the year, in small but seemingly increasing numbers.

When, on 6th June, I photographed the parents, the nest almost certainly contained young, for they were constantly bringing food to the nest-hole. It was difficult to recognise of what this consisted since it was often crushed into an unrecognisable mass. Frogs certainly figured on the menu, occasionally a small fish, and I think a lizard, but the most intriguing item was a huge mole-cricket with the most wonderful digging apparatus I have ever seen. In fact, besides scrapers and shovels, it appeared to have capacious grabs with which to scoop up and eject the waste material behind it. Its scientific name is, I gather, *Schizodactylus monstruosus,* and it is really a desert species. The lower slopes on the northern side of the Vale around the larger side valleys are of rather an arid stony nature, so the insect may have reached this perhaps unusual but congenial habitat from across the watershed from Ladakh and the Indus Valley. When Colonel Phillips photographed this same bird on the 12th June, he averred that the nest then contained well-grown fledglings and that the food being brought to them 'always consisted of frogs or the battered remains of lizards' (Vol. 46, p. 99). In this photograph facing p. 91 the victim looks to me like a frog which has also undergone the violent crushing treatment which appears to be the fate meted out to all but the smaller and softer items when intended for the young brood.

The kingfisher proved very easy to photograph, posing time after time on a large pile of stones facing the nest-hole. These stones were a godsend, since the only position for the tent and camera, if focussed on the hole, faced the strong light coming over the top of the quarry bank. I built up another stack to get myself level with the bird on its favourite perch, and it is this mound, and the hiding-tent upon it, which are clearly reflected in the bird's eye.

On 8th June we left the houseboat at Ganderbal and moved up to the Akhal rest-house. This is a somewhat dilapidated forest hut, seldom used I should think, about half a mile from the left bank of the river opposite Kangan (elevation 5,800 ft.). A very dirty tonga took us along the so-called new motor road as far as the Kangan D.B., and I hobbled the remainder of the way with a few rests which served to give me a chance of observing the birds around us.

I have always considered Kangan to be the point in the Sind Valley where the returning trekker first meets with a predominantly 'Vale' fauna. This certainly holds good for the valley bottom where fields and parklands slope up to the forest rim. Starlings, House-Sparrows, Mynas, White-cheeked Bulbuls, Drongos, a Roller or two, and Tickell's Thrushes, were all noted on that first walk. And, before we left, we had seen many of the common fry of the drier parts of the Vale with the notable exception of the Paradise Flycatcher. Indian Orioles were not uncommon, but surely Stuart Baker has got his data wrong in recording orioles nesting at Sonamarg! Did he mix up Sonamarg with Sonarwain, I wonder? I have never seen orioles at any distance from the Vale, except of course below it in the Jhelum and Lower Kishenganga Valleys.

Black Bulbuls were noted as being fairly numerous, especially along the forest edge. That was to be expected, since they winter in small numbers in the Vale and in large numbers below it, moving up to the Vale in flocks in the spring, to spread themselves in May about the lower ends of all the side valleys where they breed on their lower slopes.

As soon as we entered the mixed forest, a few hundred feet above Kangan and the river, we were in another world. A Forktail was disturbed within fifty yards of the hut, and Black-and-Yellow Grosbeaks were calling as they fed their way through the summits of the tall pines. Willow-Warblers, Red-breasted Flycatchers, and a pair of Small-billed Minivets were seen as we crossed a little glade; while Meadow-Buntings were moving about the undergrowth. The harsh cacophony of a Small Cuckoo drifted down from the slopes of a thickly-wooded nullah, to be followed shortly by the hoopoe-like notes of a Himalayan Cuckoo. I felt I had chosen well, and even if a mile in any direction were to remain my limit of travel, I would have plenty to do.

My first victims were a pair of Kashmir Pied Woodpeckers. June seems to be late for finding nest-holes still in use. As most of my incursions into the hills had started from halfway through that month, I had not had many opportunities of photographing this bird. The few occupied nest-holes which I had noted at odd times, had often been in difficult, some in well-nigh impossible, situations in bare trunks 40 or more feet from the ground. I have noticed, however, that in the mixed forests of Kashmir, this woodpecker shows a decided preference for boring its nesting hole into the trunks and branches of chestnut trees.

On our very first outing, on the morning of the 9th, I heard the unmistakable squealings of young woodpeckers emanating from the far side of one of these trees. On going round, I could at first see no signs of the nest for I was looking well up into the tree. Imagine my delight when I glanced down at the main trunk to discover that I was standing with my elbow almost blocking their lair. I have never seen quite such a low nest; the majority run from say 12 feet to almost any height. We returned to camp and put the hide in position that evening.

Surrounding trees rendered the light rather poor, added to which the 10th proved to be a cloudy day. I perforce had recourse to the silent shutter and slow speeds, but between 10 o'clock and 1.15 p.m. exposed a dozen plates. Of these only half were worth keeping, for the birds proved altogether too tame, moving their heads in characteristically jerky fashion in the middle of exposures taking no notice whatsoever of the shouts and whistles whereby I attempted to make them freeze. The five negatives which showed no movement are all very good, so really I have nothing to complain about. The food brought to the young was varied but hard to recognise. One item appeared to be a small cocoon, no doubt with its larva or pupa within, while another was a large butterfly or moth.

I had sent Khalik Khan a mile or so up river to where I had made out some large islands. He failed to trace the presence of any Ibisbills, but on one of the larger and more accessible were no fewer than 4 sandpipers' nests, a Hodgson's Pied Wagtail's, and a Red-wattled Lapwing's. I visited this island on the 15th and found the sandpipers' nests to contain c/4, c/4, c/3, and c/2. On that day the Red-wattled Lapwings completed their clutch with the laying of the fourth egg. A close inspection of this nest showed it to consist of some 200 sheep droppings, many bits of dry horse dung, and tiny pieces of wood and bark, the flotsam of the island's rim, as well as small clods of earth and some pebbles. This lapwing is by no means uncommon along the side rivers in their lower reaches where there are islands or waste land along the banks. As is usual with this annoying bird, any man, bird, or beast foreign to the island was invariably met with a torrent of abuse and much ostentatious flying as soon as their boundary was violated. I cannot say that I find the Red-wattled Lapwing protectively coloured to any marked degree. The large expanse of deep black on the breast and head contrasts too highly with the adjacent white parts. The earthy back is inconspicuous enough, but there is little difficulty in picking out the sitting bird from either the front or side, however still it remains.

I wasted a whole morning on that island, obtaining no photographs of the sandpipers, in spite of having had rough hides up for a couple of days, *but with no dummy lens in position*; and some mediocre negatives of the Pied Wagtail on its nest where the patchy light and strong shadow cast by the sun proved too much for me. I tried shading the nest with an old umbrella, but even these birds kicked at that treatment and I had to remove the offending gamp.

A number of useful paths radiated in all directions from the forest hut. Two led directly up and down the valley following the lower rim of the forest; two more ascended long spurs into the hills. The more northerly of the latter probably joined the route over the Hyan Pass, but we could not follow it far enough to see.

On the days between the 10th and 15th we explored these different tracks. Those along the edge of the trees disclosed that here was primarily the domain of Rufous-tailed Flycatchers in large numbers, Blue-headed Rock-Thrushes, and Dark-grey Bushchats. I found nests of all three species, but two Rufous-tailed Flycatchers' were in sites of which I had had no previous experience. They were, in fact, in identical situations in perrotia scrub, both of them built across small horizontal forks, rather open to veiw and about 4½ feet from the ground. The small young ones in one of them were found dead on the 18th so I examined the nest in detail, finding it to have been built almost entirely of moss with some bits of bark skin intermixed. A quantity of grey lichen plastered its exterior. The bulky little cup was lined with fine hairs and three or four downy feathers. The cup measured 1⅞ inches across and 1¼ inches deep.

The Rufous-tailed Flycatcher is one of the commonest birds in Kashmir. Leave the Vale in any direction you please, and it will be amongst the first birds to be met with in any numbers, particularly along the edges of the woods; in the spruce and pine forests, into the fastnesses of which it perhaps does not penetrate far owing to the gloom and lack of undergrowth; in the mixed forests where it will be found everywhere; and even in well-wooded parkland which cannot be called true forest at all. It particularly delights in the edges of those forests where it gets varied types and heights of trees, and glades surrounded by well-developed undergrowth such as the perrotia scrub mentioned above. In spite however of its numbers it is not an obtrusive bird, for it makes no spectacular dashes into the open after winged prey but catches its food while flitting quietly from one perch to another or when fluttering about the middle foliage and in amongst the boughs of the pines. In its nesting habits it is equally versatile, this adaptability perhaps accounting for its success as a colonist, for its nesting sites vary to a considerable degree. The nest may even be found on the ground, particularly on very steep hillsides where it is sometimes placed at the foot of a small bush or in a depression in a nearly vertical bank. These ground sites are, I think, exceptional. In bushes it is generally about 4 to 6 feet up, but when we come to the trees, it chooses sites such as against the trunk where a horizontal branch springs out at 10 to say 15 feet up. It may at times be placed across a horizontal fork in the smaller branches at a considerable height from the ground. Amongst the twigs springing from the crowns of pollarded trees is also said to be a favoured site.

During my peregrinations to and from the Rufous-tailed Flycatchers' I noticed four other species nesting within sight of the path. Two pairs of Red-breasted Flycatchers had their homes not a hundred yards from the hut, one in a 4-inch sapling. This type of site seems to be chosen above all others, so much so that the thinner the stem, the more inclined I am to tap it if it shows a knot-hole or slit auguring a hollow interior. The fact that the space within must often be very cramped and preclude anything but the scantiest use of nest materials does not seem to matter: it may in fact be an advantage, for I have seen a nest which consisted of half a dozen skeleton leaves and a little debris requiring but a minimum of time and labour to construct. Occasionally large cavities are used, that is, large for the size of the bird, but it is the little holes in little trees which are most favoured, and these at no great height from the ground, frequently only three or four feet up.

The other species referred to were the Hoopoe, the Indian Bluechat of which more later, and the Eastern Meadow-Bunting. On the morning of the 18th, I walked past this last nest twice. The first time would be about 7.30, when I noticed nothing suspicious. Imagine then my surprise and interest on returning a couple of hours later to find the three young ones scattered in a line below the nest, two about 6 inches from the rim, already dead and being attacked by vicious red ants, the third, just by the rim, lethargic but still alive. Two inches from the opposite rim there lay a Cuckoo's egg. I of course knew that there was an Asiatic Cuckoo in this area; indeed I had heard the bubbling note not so long before, probably proclaiming the deposition of this very egg. But what had transpired to bring about this extraordinary situation? From the egg's colouration I judged the Cuckoo to be victimizing Rufous-backed Shrikes, but Forktails too would no doubt have accepted this egg. These lovely birds were, or had been, present on the little stream which provided our water, for I found traces along its banks of five nests, one possibly new. Cuckoos will, I know, 'condition' their supply of nests by destroying the odd one when occasion arises, and are at times even forced by adverse circumstances to lay in nests of birds whose eggs are not in the right state or belong to species with eggs widely divergent in colour from their own. But this is the first time I have ever heard of a cuckoo attempting to introduce its egg into a nestful of young. That this bird had been compelled to lay in a nest belonging to other than its usual fosterer was in this case patently obvious—Meadow-bunting Cuckoos have evolved a bunting-like egg—but had the cuckoo, or some subsequent marauder, pulled out the chicks? Or was this the work of frenzied parents, who, in the extremity of their anguish and excitement, had destroyed their own nest and sacrificed their offspring in the act of rejecting this monstrous imposition? Since the cuckoo's egg was also outside the nest, about the construction and position of which there was nothing to have prevented the cuckoo from depositing the egg well and truly in the cup, I feel the latter must have been the case. But there the mystery must remain and I will pass on to the Bluechats.

I had put up a dummy hide on the 11th, the day on which we found their nest. Now, on the 18th, it contained callow young. The site chosen was in the bottom of a narrow water-course in the forest. It lay in a cavity amongst some earth and stones on a raised hump which might be calculated to avoid the flood in the event of a spate. It was a gloomy spot, fairly open in itself, but the proximity of the trees and undergrowth, and the narrowness of the ravine, precluded much light. It was, in fact, one of those typical sites so beloved of this species which seldom comes out into the open in the nesting season. A pity this, since the penetrating notes of the highly coloured males commence to be heard throughout all the woods and gorges of Kashmir from quite low elevations to 10,000 feet or so from late May or early June, according to elevation. The song is quite unmistakable, a rapid jumble of rather thin notes warmed up, as it were, by three exceedingly penetrating whistles proclaimed unseen from the depths of the viburnum or other scrub which it frequents. I have on the odd, but very rare, occasion seen one mount to a lower branch of a pine tree to broadcast its calls.

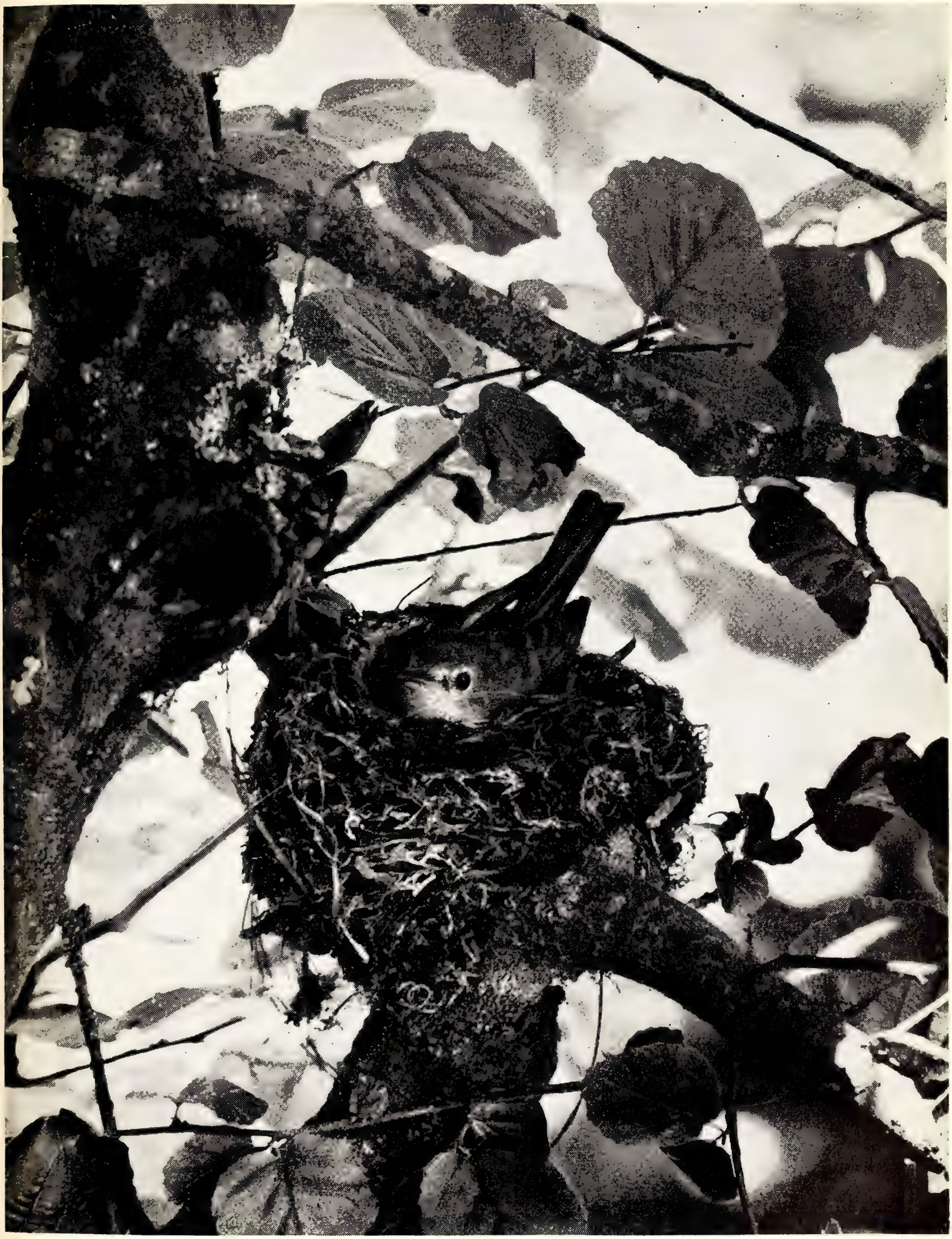
Though cautious, Bluechats are not hard to photograph. Unfortunately the differences in depth of tone between the dark blue upper plumage and the dull chestnut of the lower parts when reduced to shades of grey, seem beyond the powers of the monochrome plate to portray. Perhaps a judicious choice of filters in order to exaggerate or restrain one colour or the other may be the answer. Both sexes came freely to my nest and remained sufficiently still for me to make use of time exposures of some length with the silent *Luc* shutter. A point of interest in an otherwise rather dull session was that both parents were noted to swallow the capsule containing the faeces instead of removing it and dropping it at a distance from the nest. Does this habit persist throughout the youngs' sojourn in the nest or only in the opening stages of their lives? I have noted the habit in the case of newly-hatched Reed-Warblers.

I have little else regarding our stay at Akhal worthy of discoursing upon. The Ibisbills were seen no more. I failed to trace the position of the nest of a pair of Short-billed Minivets, so filled in time at one of the Red-breasted Flycatchers', attempting to catch the characteristic stance with tail cocked up at an angle and wings slightly adroop. The light was poor and the results still poorer. On the way down to Kangan on the day we returned to the boat, I saw a Brown-fronted Woodpecker. The elevation here, 6,000 ft., is, I think about the limit of this species's upward travel. It is a woodpecker of the lower levels in the foothills but some are resident in the Vale, their numbers being augmented in the spring by fresh arrivals from lower down.

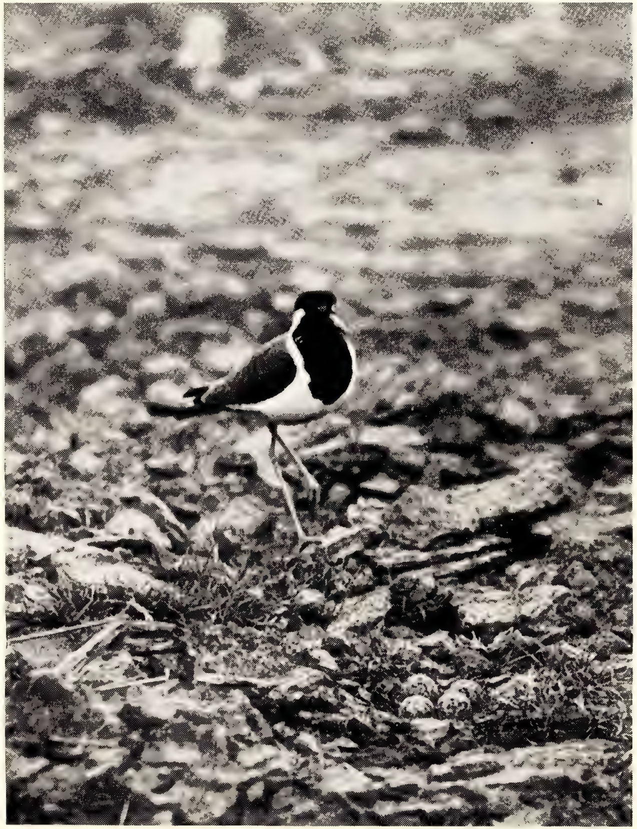
* * *

As I have talked about the silent *Luc* shutter, before I close I would like to add a few observations to what I wrote in 'Bird Photography in India' in Vol. XL, pp. 666-680. That paper was written eleven years ago. A lot of water has flowed under the bridge since then, but what I said in it in the main holds good, requiring little correction but some considerable amplification. I said nothing about shutters, insufficient on the subject of cameras, and only little really about lenses. In fact, on the last point a definite slip of the pen remained undetected even when correcting the proofs. On page 674, talking of lenses for use in bird photography, I remarked that their focal length should lie between 8 and 12 inches, preferably nearer the latter. I intended to write, *nearer the former*. With lenses beyond 8-inch focal length, the bellows extension required when photographing small birds at a distance of 3 to 4 feet from the hide is altogether too great, and even if the camera front can be racked out sufficiently far, its stability comes into question. The tele-anastigmatic lenses will of course give a large enough image with a comparatively small bellows extension, but they give little depth of field which militates against their use for normal subjects. The size of image on the plate should be not much less than an inch or 3/4 of an inch in length if one is not to lose feather texture and minute detail, so it may not infrequently be necessary to place the camera as close as three feet from the smallest birds and their nests, requiring, even with an 8-inch lens, a very long bellows extension.

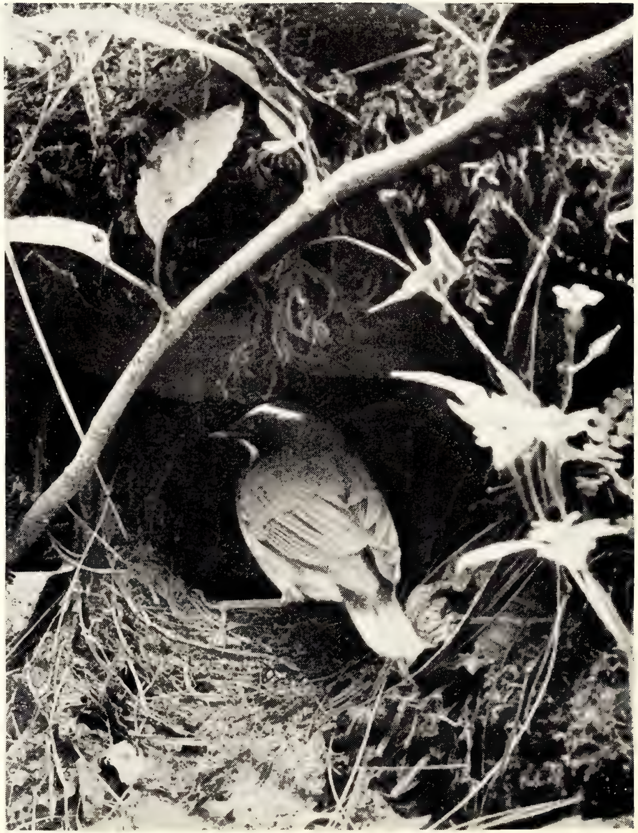
This brings me to another point. I related how I had come to the conclusion that it might be found possible to reduce the size of



Rufous-tailed Flycatcher on nest.



Red-wattled Lapwing approaching nest.



Male Indian Blue Chat at nest.

Photos *R. S. P. Bates.*

negative material to 3½ by 2½ inches, which would render a considerable saving in expense, weight, and bulk of apparatus, all three very important factors. Since 1939 I have used that size of plate, and all I hoped for in those respects has certainly proved in favour of its use. In practice, however, certain limitations have come to light, and those limitations are so serious as largely to outweigh the favourable considerations.

As previously suggested, the image on the plate of even the smallest bird has to be little if anything under one inch in length. Measure off a lozenge of that length about the middle of a 3½ by 2½ inch plate and it may appear to give ample space above and below, and on either side of it, for sufficient surroundings from which to compose a picture which will tell a story as well as give balance to the whole. Remember, however, that a bird is an independent agent over which we have little or no control. We cannot caution it to remain still in the exact right place for our photography. And if our calculations as to the position it will occupy go astray, with such a small plate we may well find the bird cut in half, or at best right on the edge where we have no scope at all for composition in the final result.

When I at length succeeded in getting a good photograph of a female Blue-headed Rock-Thrush, the bird unexpectedly landed on a stump so close to the camera that its image filled most of the plate. In this case it did not matter so much as all else except the top of the stump was distant and quite out of focus. All things considered I am in favour of the quarter plate, although the other day I heard a very well known bird photographer say that he was contemplating reverting to the 5 by 4 plate. I can imagine situations where the quarter plate of 4¼ by 3¼ inches would prove inadequate, particularly when contending with the birds of a heronry or those massed cohorts of waders on the edge of the tide. 'Estuary photography' may and often does call for getting a large number of birds all in focus over a wide area and through a considerable depth of field. And that leads to the consideration of cameras.

There is really no such thing as an all purpose camera. But where, owing to the depth of one's pocket, a single camera has to be considered, then it must in my opinion be a reflex. For work from the hide I would much prefer one of those contraptions usually known as the field camera, that is a bellows camera capable of long extension and provided with various movements, the most important of which is the swing back. A fixed and very limited tilt can be imparted to the back of a reflex without much difficulty in the way of structural modification, but to get the best results, and obtain the extreme depth of field so often essential in bird photography, a camera with a back which can be swung through a considerable arc is imperative. So many of my photographs can be considered only of second rate value, thanks to out-of-focus foregrounds and a narrow belt of sharp focus across the middle of the plate. The depth of this strip can of course be increased by stopping down—which, don't forget, proportionately increases the exposure times—but two controls, tilting the back and stopping down, whereby to obtain an area of perfect definition enclosing the whole of the foreground to some way beyond the bird so as to include at least the further rim of the nest and its immediate background, are better than one. And it is the swing back which provides us with the greater control of the two over the depth of field, a control which in the event of poor lighting may enable us to get a well-focussed picture with a comparatively large stop and so with a length of exposure the bird can stand. No reflex camera can have such a swinging back without it ceasing to be usable as a reflex, so where possible leave the reflex for its specialized uses and in the hide employ the field camera. Modern plates are so fast and have such great latitude compared with those of say 25 years ago that the bird photographer's task has undoubtedly been simplified in many ways. But I am quite sure that no present day B.P. would dream of using that plate speed on birds at the nest merely to make certain of eliminating all signs of movement in his subjects by the employment of rapid exposures. Rather does he make use of this increased emulsion speed by stopping down further than of yore, say to *f22* or even *f32*, thereby increasing the depth of his belt of sharp focus. There are now silent or near-silent shutters which give him a better chance of success with the comparatively long exposures he has always been wont to employ. My advice is to stick to those exposures, even though it will still entail throwing a proportion of the negatives on to the rubbish heap after development.

For years I put up with the clatter of focal plane shutters; or rather I induced the birds to put up with their devilish noises. And it is extraordinary how soon most birds do become oblivious to the sudden bangs of the descending blind. Nevertheless, the use over the last ten years of the *Luc* silent shutter has served to show me just what I missed by failing to indulge in a shutter of this type as soon as it came on the market. For, excepting a slight click or scratching noise after the exposure is virtually over, the *Luc* shutter is to all intents and purposes quite silent in operation. A postwar British-made version is now on the market, so there is no excuse for any serious-minded B.P. not possessing one. The fitting of it may of course entail some structural alterations to cameras, such as the provision of an extension box between the lens and the original lens panel, since in my view it is quite wrong for the photographer to have the shutter fixed on to the front of the lens where the bird can see the opening and closing of the leaves.

This shutter, incidentally, has three settings. *Open,* for focussing and to enable one to use for rapid exposures the focal plane shutter if so fitted to one's camera. Secondly, a *time* setting for long exposures; and thirdly, an *instantaneous* setting whereby the speeds are controlled by the rapidity with which one manipulates the antinous release. The shortest exposures obtainable with practice are in the neighbourhood of 1/40th second. Personally I have found the *time* setting the most silent and the most useful. With it short exposures of from $\frac{1}{4}$ to 1/10 second are quite feasible and in fact I often use much longer exposures than these.

On reading over the last couple of pages, I feel I have perhaps given the impression that the reflex camera is a handicap rather than an asset in the hide. This is by no means the case. I merely wish to stress the advantage which the swing back of the field camera undoubtedly confers on the bird photographer when he is faced with the necessity of obtaining extreme depth of focus, or of obtaining sufficient depth of focus in gloomy surroundings where the antics of the bird entail the certain use of comparatively short exposures.

This brings to an end the last of the three articles I had in mind on the subject of Kashmir's birds. Whether I shall ever have the opportunity to collect further data is in the lap of the gods. I hate to think I may never again wander with field glass and camera along those wonderful valleys, climb the wooded hill-sides, fragrant with the scent of the pines, to the upper margs and flower-starred pastures, or idle in a shikara through the shady waterways of the Vale listening to the flutings of the orioles and the songs of the thrushes. Perhaps I shall: one never knows one's luck.

SOME WEST BENGAL PLANTS[1]

BY

J. C. CULSHAW

In his introduction to 'Bengal Plants', published in 1903, the late Sir David Prain is extremely modest in his valuation of his work. He makes no claim to be comprehensive. 'Of Northern Tirhut we know very little. . . Our knowledge of the Chota Nagpur flora is still far from adequate: much has yet to be done. . . Our knowledge of this most varied and interesting province (sc. Orissa) is almost blank. . . Of Tippera we know even less than we do of Orissa. . . Our acquaintance of the southern portion of this tract (sc. West Bengal) is of the slightest: but for some references by Roxburgh to interesting species from the ''Midnapur jungles'' it would be altogether blank. . . The time for the preparation of a complete local flora of the Lower Provinces has not yet come: much special work is still called for in many of the outlying districts. Yet something must be done, if the attention and interest of those capable of rendering the necessary assistance is to be invoked. . . The assistance that it is hoped many of those who use the present work shall be willing to give must be awaited before an attempt can be made to issue what should aim at being a complete Local Flora.'

After such modest words in the introduction one is almost surprised to find that his work includes a list of just over three thousand species and varieties. But Prain thought there should be more. The assistance he hoped for may have been offered. If so we have seen very little of the results of it in print. Meanwhile Bengal has been partitioned, reunited, and partitioned again. Tirhut, Bihar and Chota Nagpur form a province of their own. Orissa forms another. East Bengal is no longer politically a part of India and a botanical exile is tempted to wonder whether she has now to cast her eyes to Lahore rather than Sibpur—again botanically speaking, of course. Perhaps some enterprising citizen of Pakistan is already contemplating a Flora of East Bengal. However that may be, it seems quite clear that Prain's 'Bengal Plants' will never be reprinted, but will remain a valuable curiosity to be handled with care in libraries, while the assistant librarian keeps a wary eye on the handler for fear that he might damage or decamp with so valuable a prize. Meanwhile what is to happen to 'Plants of West Bengal'?

Prain admits that his records of that area are limited. Western Bengal for him does not correspond exactly with the modern political province. For him it stretches westward from the Bhagirati and the Hughli to the eastern base of the Chota Nagpur ghats, its composition being a narrow belt of deltaic alluvium along its eastern edge, with a non-alluvial plain to the west, passing gradually into the submontane forests below the eastern ghats of Chota Nagpur. Prain says in his introduction, 'We owe to many collectors, but more than any others to Kurz and Ball, our fairly adequate knowledge of the northern half of this non-alluvial tract'. 'Fairly adequate' seems a high claim indeed from Prain, when one remembers his oft repeated confessions of ignorance of the area covered. For Central Bengal, part of which is also included in the modern political province of West Bengal, his claims are even higher. 'Of this tract, as of the Sundribuns, we possess a knowledge that is probably practically complete.' There remains however the southern half of Western Bengal, of which, says Prain in a passage already quoted, 'our acquaintance is of the slightest: but for some references by Roxburgh to interesting species from the "Midnapur jungles", it would be altogether blank.'

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[1] In this paper I have followed Prain's nomenclature throughout, except for species not mentioned by Prain, for which I take the names from Hooker's Flora of British India.

It was my good fortune to be stationed in this area from 1944 to 1947, and during that period I made some casual collections of herbs and blossom. The following lists are the result. They make no claim to be comprehensive: in fact they are definitely the result of casual rather than intensive collection, and there must still be scores or more of interesting plants that have been overlooked. A glance at the lists will show that they contain no grasses, reeds or rushes, merely because I nurse a prejudice against those families and have never made the effort to identify them. Apart from this, the most remarkable thing about the lists seems to be that they have not been recorded from West Bengal before.

All the plants in these lists have been picked in the southern half of the Bankura district, or along the northern edge of the Midnapur district: from Bankura in the north to the former R.A.F. station south of Salboni in the south, on the railway line between Bankura and Midnapur: and from the western borders of the Bankura and Midnapur districts to Amlagora in the east. The vast majority of them were picked in the Raniband and Raipur thanas of the Bankura district. Out of a total of 320 species I have not included in the lists 131 which Prain records from all the provinces, 38 cultivated species, and 50 already recorded in Prain as from Western Bengal or the western provinces. The remaining 101 comprise:—

1. List A. 62 plants not recorded by Prain for either Western or Central Bengal, or (with three exceptions) the Sundribuns—the area which covers most of the present political province of West Bengal.

2. List B. 18 plants recorded in Prain for Central Bengal, but not for Western Bengal. 'Having regard to the composite nature of West Bengal as a botanical province', says Prain in his introduction, 'and to the fact that its alluvial rice-plain is neither very extensive, nor at all distinctive, the province has not been cited in the list under any species that belongs to West Bengal merely because it occurs in these rice-fields. Whenever therefore a plant is cited as occurring in West Bengal, it is to be understood that it has been collected to the west of the narrow semi-aquatic rice-plain, in the non-alluvial portion of the province.' Many of the 18 species recorded in this list are species one might expect to find in association with an alluvial rice-plain: they have been recorded here however because

they do in fact occur in the western non-alluvial portion of the province, and qualify therefore for inclusion as West Bengal plants according to Prain's definition.

3. List C. 21 species recorded in Prain as occurring in most of the provinces. This list merely suffices to record that 'most' in these particular cases does in fact include 'West Bengal'.

List C then calls for no particular comment. The same may be said of List B, except perhaps for an exclamatory comment of 'and how!' on Prain's remark that *Evolvulus nummularius* L. was, though confined to Central Bengal, in 1903, rapidly spreading. One notices also a slight admixture of Chota Nagpur elements in a list of what one may consider chiefly as Central Bengal plants. This tendency is even more marked in List A, in which 48 of the 62 species are already recorded in Prain for Chota Nagpur. This is only to be expected as the greater proportion of the plants on the list were collected in an area with a strong sal-forest association (*Shorea robusta* Gaertn. f.). They have not however been previously recorded from either the botanical or the political province of West Bengal. The same applies to the remaining 14 of the 62 species but their associations are somewhat different.

Of these 14, three are recorded from Bihar—*Cotula anthemoides* L. is recorded for Bihar alone with the additional note 'very rare'. I myself found it on only one occasion, but Haines, in his 'Botany of Bihar and Orissa', records it 'on the Gangetic plain from Rajmahal (Santal Parganas) westward', which would seem to argue a fairly wide distribution. *Pulicaria foliolosa* DC. is also recorded by Prain as occurring in Tirhut and North Bengal as well as Bihar, and Haines comments, 'banks of the Ganges, Santal Parganas, Kurz.' *Aerua lanata* Juss. is recorded by Prain as from East Bengal as well as Bihar, but Haines's comment, 'a common weed, usually in open village lands', makes it surprising that it has not been recorded from other districts also.

Of the 11 remaining, seven—*Medicago lupulina* L., *Ammannia cordata* W & A., *Ludwigia prostrata* Roxb., *Randia longiflora* Lamk., *Vandellia hirsuta* Bth., *Vandellia scabra* Bth., and *Bonnaya veronicaefolia* Spreng. var. *verbenaefolia* Bth.—are recorded by Prain as occurring in either North or East Bengal, in some cases in both. The most remarkable fact about these seems to be that they have never been recorded from similar situations, of which there must be any number, in Central Bengal, but they no doubt occur in individual herbaria collected in that area, and it would be interesting to know how many of them have occurred. The four plants remaining in List A call perhaps for individual comment.

Ipomoea Pes-caprae Sweet. (*I.biloba* Forsk.) is included in this list without real justification as Prain has already recorded it from West Bengal. It has however its own interest. Of this plant Prain says: 'Orissa; Sundribuns: Chittagong: on the seashore among sand, common. Mr. Kurz once found the plant growing on a hill near Raniganj in W. Bengal: how it found its way there is unknown.' I enter this plant on the list to record that it has been found again in the southern portion of West Bengal, some 90 miles south of Raniganj, north of the village of Amjhor in the Raipur thana of the Bankura district. Prain speaks of it as a sand-binding, littoral creeping perennial, and it may be that it was introduced for this purpose as it grows profusely on the embankment of a bandh, built as famine relief work, over which the main road passes.

Utricularia racemosa Wall. var. *filicaulis* Cl. is not recorded in Prain. I find this difficult to account for except by the supposition that Prain did not recognize Clarke's variety, as he already records *Utricularia racemosa* Wall. from Chota Nagpur and Bengal. This plant I have recorded in list A. The distribution of var. *filicaulis* Cl. is given as 'from Nepal and the Khasia Mts to Ceylon and Tenasserim' in the Flora of British India iv. 333. This variety is recognized by Haines as commoner than the type. It is not of course to be confused with *U. coerulea* L. of the Flora of British India, though it has sometimes been known by that name. Haines 'Botany of Bihar and Orissa' p. 645 is of course the locus classicus for clearing up this confusion, which is said to go back originally to Linnaeus himself.

The last two on the list are rather more surprising discoveries. *Hoppea fastigiata* Cl. was found in November 1945, quarter of a mile west of Gadara on the main road between Sarenga and Chandrakona Road railway station. Its distribution is given in the Flora of British India iv. 100 as 'S. Deccan peninsula, Mysore, Moulmein and Ceylon', and in Gamble's Flora of Madras as 'North Circars, in Ganjam; Deccan, in Mysore; West coast from South Canara to Travancore'. It is not recorded in either Prain or Haines. Nor is *Grewia humilis* Wall., which is recorded in the Flora of British India i. 390 as from 'Ava, on the Irrawaddy, Wallich; Burma, Kurz.' It was found in July 1946 in sal-forest between the villages of Tantidanga and Telijant, in the Raipur thana of the Bankura district. The appearance of these two plants seems extremely difficult to account for. It is, I suppose, conceivably possible that seeds of *Hoppea fastigiata* Cl. may have been imported into West Bengal together with rice seed from South India, during the famine period of 1942-3. For the appearance of *Grewia humilis* Wall. I can see no way of accounting except by the apparently incredible but not completely impossible assumption that it has previously been overlooked by collectors in Bengal.

Prain's 'Bengal Plants' records 3052 plants (including 35 in the Appendix and 153 varieties). Of these only 168 are recorded from West Bengal. There are in addition 457 recorded as appearing in all the provinces, 48 recorded from 'the western provinces', and 163 recorded from 'most of the provinces', which would make a possible total of 836 species and varieties for the botanical province of West Bengal. Out of a possible total of 836, a collection of a mere 320 species makes a somewhat meagre showing, but of that 320, no less than 80, a quarter of the total number collected, may be looked upon as new records. For the political province of West Bengal, the record must be far greater as the majority of the 268 plants recorded in Prain for Central Bengal, but not West Bengal, would have to be included, in addition to the plants of the Sundribuns, and of course the Darjeeling plants, which Prain never attempted to include in his work. Statistics are dangerous material for argument, but it might not be too rash to assume that a collector who found all the 836 species recorded by Prain for West Bengal might find at least another fifth or sixth as new records, which would bring the list for Prain's botanical province of West Bengal to over a thousand species and varieties, and increase the number for the political province to a total past my powers of computing. This paper is written in the hope that it may inspire some patriotic citizen or denizen of West Bengal to achieve this!

In the lists appended the second column of figures indicate the serial number of the species or variety in Prain's 'Bengal Plants'. In the three cases where no such number occurs the plant named not included in Prain. The abbreviations indicate the distribution recorded by Prain and are for the most part self-explanatory. A list of them is however added for the purpose of greater clarity.

May I, in concluding these notes, express my thanks to Dr. S. K. Mukherjee and the staff of the Sibpur Herbarium for invaluable help in the identification of specimens, and also to Dr. W. B. Turrill and the staff of the Kew Herbarium for their clarification of certain points.

Abbreviations

CN	Chota Nagpur
O	Orissa
Bh	Bihar
T	Tirhut
N	North Bengal
C	Central Bengal
E	East Bengal
S	Sundribuns
Ch	Chittagong

LIST A.

(62 Plants not previously recorded by Prain for West or Central Bengal)

Caryophyllaceae

1. 111. Polycarpaea corymbosa Lamk. ... CN Bh N E

Dipterocarpaceae

2. 145. Shorea robusta Gaertn. f. CN N

Malvaceae

3. 195. Thespesia Lampas Dalz. & Gibs. ... CN Bh

Tiliaceae

4. Grewia humilis Wall.

Zygophyllaceae

5. 259. Tribulus terrestris L. ... CN O Bh T

Celastraceae

6. 334. Celastrus paniculata Willd. CN N

Anacardiaceae

7. 392. Buchanania latifolia Roxb. CN O
8. 400. Semecarpus Anacardium L. CN Bh

Leguminosae						
9.	549.	Tephrosia pumila Pers. ...	CN	Bh		
10.	436.	Crotolaria sericea Retz.	CN		N E	Ch
11.	580.	Medicago lupulina L. ...			N	
12.	610/2.	Desmodium gangeticum DC. var. maculata Bak.	CN	Bh T		
13.	625/2.	Alysicarpus bupleurifolius DC. var. gracilis Bak. ...	CN	Bh		
14.	643.	Indigofera arborea Roxb.	CN			
15.	662.	Cassia mimosoides L. ...	CN		N E	
16.	673.	Bauhinia purpurea L. ...	CN	Bh	N E	
Lythraceae						
17.	827.	Ammannia cordata W&A.			E	
18.	832.	Woodfordia floribunda Sal.	CN	Bh	N	
Onagraceae						
19.	846.	Ludwigia prostrata Roxb.			N E	
Rubiaceae						
20.	942.	Hedyotis pinifolia Wall. ...	CN	Bh		
21.	943.	Hedyotis hispida Retz. ...	CN	Bh		Ch
22.	971.	Gardenia gummifera L. ...	CN			
23.	980.	Randia longiflora Lamk.			E	Ch
Compositae						
24.	1024.	Vernonia Roxburghii Less. ...	CN	Bh		
25.	1063.	Gnaphalium luteo-album L. var. multiceps Hk. f.	CN O			
26.	1068.	Vicoa auriculata Cass. ...	CN	Bh T		
27.	1070.	Pulicaria foliolosa DC. ...		Bh T	N	
28.	1084.	Blainvillea latifolia DC. ...	CN			
29.	1103.	Cotula anthemoides L. ...		Bh		
Campanulaceae						
30.	1132.	Lobelia trigona Roxb. ...	CN		N E	
31.	1140.	Cephalostigma hirsutum Edg. ...	CN			
32.	1142.	Wahlenbergia gracilis DC.	CN	Bh	N	Ch
Oleaceae						
33.	1191.	Nyctanthes Arbortristis L.	CN	Bh		
Apocynaceae						
34.	1212.*	Vinca pusilla Murr. ...	CN	Bh		
Gentianaceae						
35.		Hoppea fastigiata Cl				
Boraginaceae						
36.	1307.	Heliotropium marifolium Retz. ...	CN	Bh		

Convolvulaceae								
37.	1335.	Merremia tridentata Hall.	CN		Bh			
38.	1344.	Ipomoea hispida Roem. & Schultz. ...	CN		Bh			
39.	1345.	Ipomoea Pes-tigridis L.	CN		Bh			
40.	1357.	Ipomoea Pes-Caprae Sweet.		O	(and Raniganj)			S Ch
Scrophulariaceae								
41.	1441.	Vandellia hirsuta Bth. ...					N E	
42.	1442.	Vandellia scabra Bth. ...					N E	
43.	1445.	Vandellia angustifolia Bth. ...	CN					
44.	1450/2.	Bonnaya veronicaefolia Spreng. var. verbenaefolia Bth. ...					E	Ch
45.	1463.	Striga euphrasioides Bth.	CN		Bh		N E	
46.	1465.	Centranthera humifusa Wall. ...	CN		Bh		N	
Lentibulariaceae								
47.	1480.	Utricularia racemosa Wall.	CN				N	
48.		Utricularia racemosa Wall. var. filicaulis Cl.						
Pedaliaceae								
49.	1496.	Martynia diandra Glox ...	CN					
Acanthaceae								
50.	1512.	Blepharis molluginifolia Pers. ...	CN					
51.	1523.	Ruellia suffruticosa Roxb.	CN		Bh	T	N	
Verbenaceae								
52.	1603.	Vitex Negundo L. ...	CN		Bh	T	N S	
Labiatae								
53.	1630/2.	Orthosiphon rubicundus Bth. var. rigida Bth. ...	CN		Bh			
54.	1660.	Anisomeles ovata R. Br.	CN					Ch
55.	1673.	Leucas montana Spreng.	CN	O	Bh			
56.	1683/2.	Ajuga macrosperma Wall. var. breviflora Hk. f. ...	CN					
Nyctaginaceae								
57.	1685/3.	Boerhavia repens L. var. diffusa Hk. f. ...	CN	O				
Amarantaceae								
58.	1709.	Aerua lanata Juss. ...			Bh		E	
Burmanniaceae								
59.	2017.	Burmannia coelestis Don.	CN		Bh	T	N	Ch

Commelinaceae						
60.	2246.	Aneilema scapiflorum Wight.	CN		T	Parasnath
61.	2249.	Aneilema nudiflorum R. Br.	CN	O		S
62.	2253.	Cyanotis tuberosa Schult. f.	CN			

LIST B.

(18 plants recorded in Prain for Central but not for West Bengal)

Sapindaceae											
1.	377.	Allophylus Cobbe L. ...		O			C		E		
Leguminosae											
2.	688.	Caesalpinia Bonducella Flem.	CN				C	N		S	
Lythraceae											
3.	826.	Ammannia salicifolia Monti.				BH	C		E	S	
Ficoideae											
4.	898.	Trianthema monogynum L.	CN				C		E		
Rubiaceae											
5.	957.	Oldenlandia paniculata L. ...					C		E		
Compositae											
6.	1042.	Blumea bifoliata DC. ...					C				
7.	1082.	Enhydra fluctuans Lour. ...					C		E		
Primulaceae											
8.	1150.	Anagallis arvensis L. ...	CN			Bh	C	N			
Asclepiadaceae											
9.	1235.	Hemidesmus indicus R. Br.	CN	O		Bh	C			S	
Gentianaceae											
10.	1284.	Erythraea Roxburghii G. Don.					C	N	E		
11.	1285.	Hoppea dichotoma Willd.	CN			Bh	C				Ch
Boraginaceae											
12.	1305.	Heliotropium ovalifolium Forsk. ...			T	Bh	C	N			
Convolvulaceae											
13.	1324.	Evolvulus nummularius L.					C				
Scrophulariaceae											
14.	1448.	Bonnaya brachiata Link and Otto. ...	CN			Bh	C		E		
Lentibulariaceae											
15.	1472/2.	Utricularia stellaris L. var. inflexa Hk. f. ...					C		E		
Acanthaceae											
16.	1560.	Ecbolium Linneanum Kurz. var. dentata Hk. f. ...					C		E		
Verbenaceae											
17.	1614.	Clerodendron infortunatum Gaertn. ...	CN		T	Bh	C	N			Ch
Euphorbiaceae											
18.	1888.	Acalypha indica L. ...					C	N	E		

LIST C.

(21 plants recorded in Prain as occurring ' in most of the provinces '. This list merely suffices to record that ' most ' includes ' West Bengal '

Leguminosae

1. 622. Alysicarpus vaginalis DC.

Rubiaceae

2. 985. Pavetta indica L.
3. 988. Ixora parviflora Vahl.

Compositae

4. 1020. Centratherum anthelminticum O. Kuntze.

Plumbaginaceae

5. 1147. Plumbago zeylanica L.

Boraginaceae

6. 1312. Coldenia procumbens L.

Convolvulaceae

7. 1360. Ipomoea obscura Ker.
8. 1366. Quamoclit pinnata Boj.

Acanthaceae

9. 1529. Phaylopsis parviflora Willd.

Verbenaceae

10. 1581. Lippia geminata H.B. and K.

Labiatae

11. 1645. Pogostemon plectranthoides Desf.
12. 1666. Leucas Cephalotes Spreng.
13. 1676. Leonotis nepetaefolia R. Br.

Amarantaceae

14. 1694. Digera arvensis Forsk.

Polygonaceae

15. 1727. Polygonum plebejum R. Br.

Euphorbiaceae

16. 1881. Chrozophora plicata A. Juss. (So Prain, but for the confusion in nomenclature vide Duthie, Flora of the Upper Gangetic Plain : iii. 105 on *C. Rottleri* A. Juss.)

Orchidaceae

17. 2081. Vanda Roxburghii Br.

Liliaceae

18. 2221. Gloriosa superba L.

Commelinaceae

19. 2239. Commelina salicifolia Roxb.
20. 2251. Aneilema vaginatum R. Br.

Marsileaceae

21. 2854. Marsilea quadrifoliata L.

THE MYSORE LAC INSECT

BY

S. MAHDIHASSAN

(*With two plates and* 1 *text figure*)

An orthodox systematist should look upon a given insect as the duplicate of a type kept in some museum. This means that in that species any one individual is so much like another that any two of them can be easily compared. This is usually so when morphological characters are well developed and of which many are present. On the contrary the lac insects, like many other coccids, are morphologically degenerate organisms, with very few features to distinguish. This apparent degeneration has been brought about by their high physiological activity which could be very well exploited in their classification, although it has not been done so far. There is a similar problem in systematic biology where some yeasts are classed as unknown fungi when there is every suspicion of their being ascomycetes which have only lost their property of forming ascospores. The microbiologist is therefore contented to differentiate them into varieties, or ultimate biological units, even though he cannot properly place them in genera. When yeasts are examined the cells of one type resemble those of the other so closely that their shape cannot form the basis of any recognition. Further, within the same species, the cells may vary so much that their morphology cannot be specified. Even their ordinary colonies look so much like one another that they cannot be recognised thereby But once they are allowed to form giant colonies each reveals its own special feature. Comparable with yeasts we find that individual lac insects show many characters in common so that the specific features are not well indicated and further there is often so much polymorphism that its interpretation becomes difficult. This explains how the majority of entomologists believe that there is only a single species from Kashmir to Travancore and from Sind to Tonkin.

The lac insect is a highly gregarious insect. It normally forms what may be called a giant colony or stick lac and the minute morphological and physiological differences, difficult to observe separately, are obvious in their totality by comparing specimens of stick lac belonging to two different species of lac insect. On the contrary it is more difficult to examine the same lac insects as individual specimens. Just as it is easy to tell at a glance a honey comb built by a small bee from that formed by a larger species, so can two specimens of stick lac be characterised when properly studied. Microbiologists have tried to interpret the difference between the smooth and rough colonies of the same species of bacterium. When likewise we try to analyse the difference in the final structure of stick lac belonging to two lac insects we get to some concrete results. The species *Lakshadia communis*, even in the larval stage, does not spread out its colony so intensely as does *Lakshadia chinensis*. The result is that, by the time the giant colony is formed, many individuals are dead but in different stages. This feature, which is hardly morphological, is nevertheless observable and has been illustrated already (1). Pressed by their neighbours the competition for space makes their bodies assume bizarre forms, another feature not found in any other species. When we come to the Mysore lac insect we find certain features not existing in other species, and these are being illustrated in this communication.

Lakshadia mysorensis is the only insect which has three life cycles a year, and while its productivity has increased its size has decreased, just as is the case with the polyvoltine silk worms. All lac insects, when they settle on a horizontal twig, settle only on the side facing the earth. On a vertical twig they settle all around it forming a regular envelope. But no vertical twig would be ideal so that even what appears as perpendicular may have its ventral and dorsal aspects, slightly inclined to the earth or away from it. When a cross section of such a twig is taken even the structure of the wood shows that the side inclined to the earth has more concentric lines while the dorsal side has relatively flat circles. The insects feeding on the ventral side also grow better than those on the dorsal. Thus the growth of the rings in the section of a twig and of the insects on that side show a distinct harmony. Fig. 1 is such a section of a *Shorea talura* twig, represented by the white inner circle, surrounded by a number of lac insects of *Lakshadia mysorensis* fixed to its periphery. The season of collection was at the end of the monsoon season, when the best growth, both of the wood and of the insects can be seen, as in Fig. 1. The insects on the ventral half, marked V, of the cross section of stick lac, are larger than on the other half, representing the relatively dorsal side of the twig, D.

Fig. 1 shows a wheel-like figure. The central white portion, as mentioned, represents the twig with its rings of wood ; the periphery is occupied by lac insects separated from one another by a spoke-like partition, being a thin membrane of lac secretion. The architecture of stick lac has been dealt with separately and on consulting it (2) the value of the present paper would be greatly increased. What is obvious is that the insects, even the largest of them, are small compared with others so far illustrated. Fig. 1 shows one insect marked 'a' as very much elongated and its length can be looked upon as the ideal for *L. mysorensis.* Yet it does not compare with that of *L. communis* or of *L. chinensis* previously illustrated elsewhere (2). Fig. 1 shows an empty cell 'b', typical of this species, almost like a narrow ellipse.

In 1901, George Watt (3) wanted to publish a monograph on lac which was issued in 1904. He probably had samples collected from different parts of India. Mysore must also have contributed to this collection which was partly deposited in the Economic Museum, Bangalore, where specimens dated 1901 are found. Mr. Trimulachar, the former Superintendent of the Museum, kindly gave me one piece from this collection. Fig. 2 shows a cross section of the dry twig as a white circular central portion. The dorsal periphery, comparable with D in Fig. 1, shows insects less developed than on the ventral half, (Fig. 2. V). The dried insect (marked 'a' in Fig. 2) compares with 'a' of Fig. 1, already mentioned. Likewise empty cells in Figs. 1 and 2 (marked in both as 'b') show a narrow elliptical outline. The

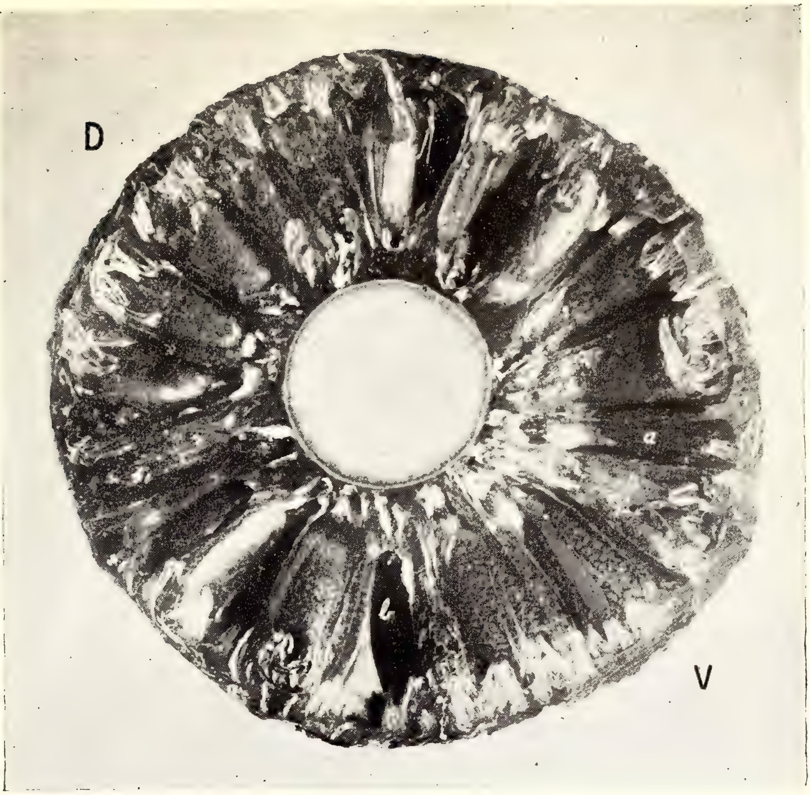

Fig. 1.

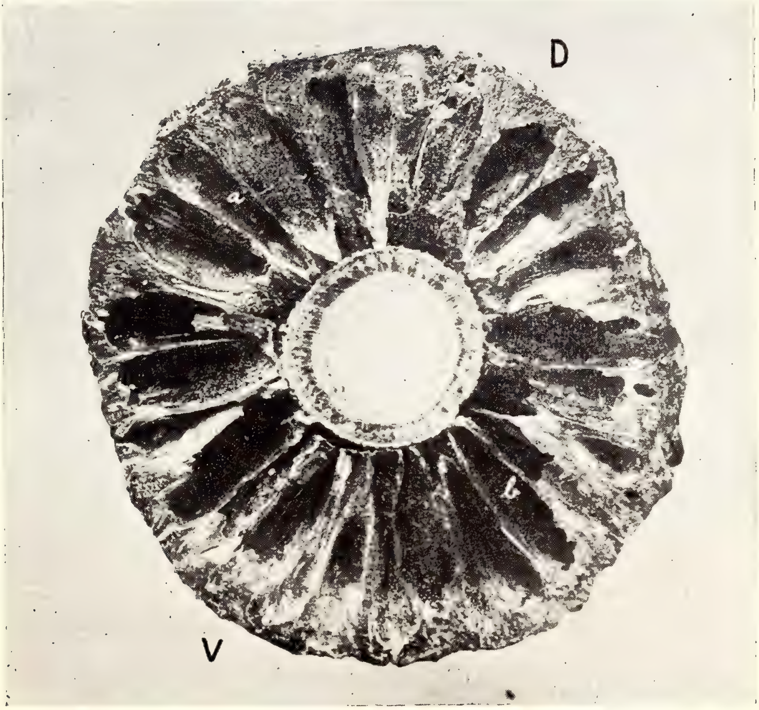

Fig. 2.
(*Explanation at end*)

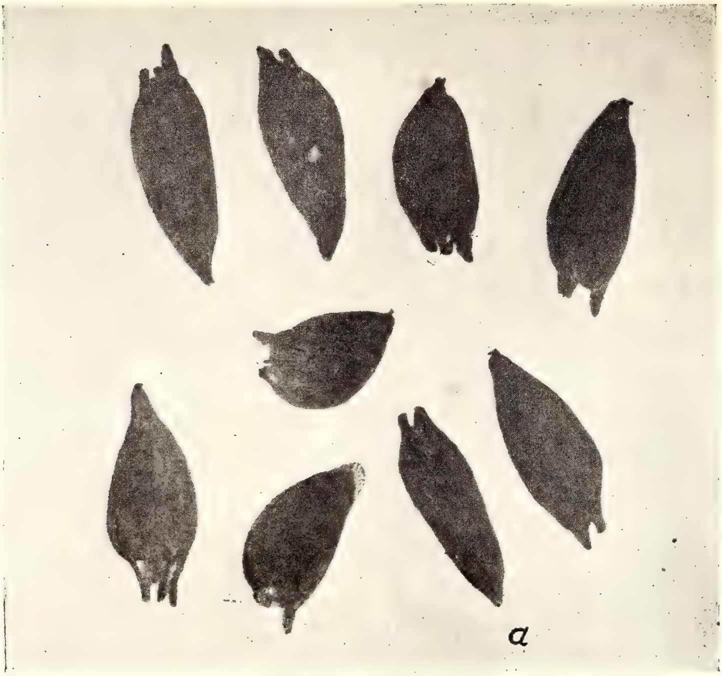

Fig. 3.

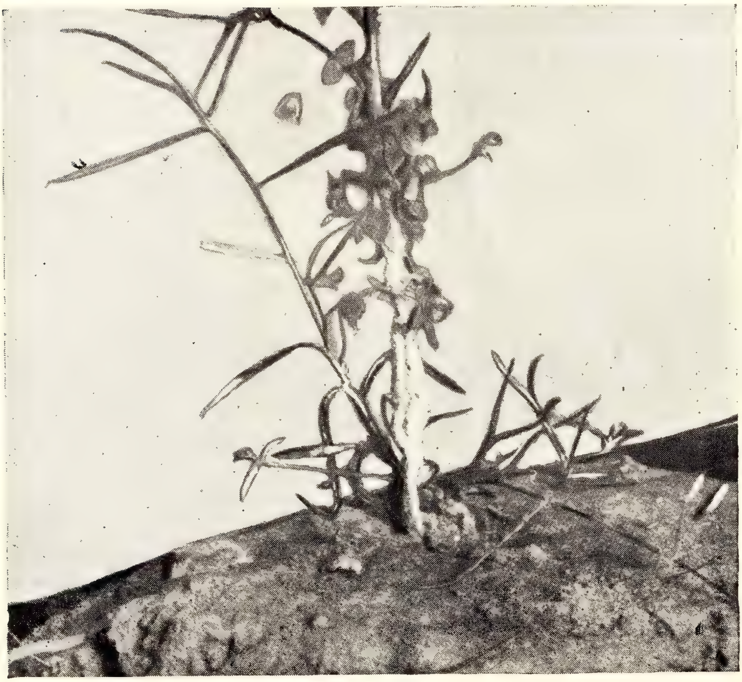

Fig. 5.
(*Explanation at end*)

lac insects arranged all round the twig, in Figs. 1 and 2, have very small bodies compared with other species.

Fig. 3 shows the Mysore lac insects devoid of their secretion products where one individual marked 'a' compares well with the objects represented in Figs. 1 and 2 with the same indication. A picture, such as Fig. 3 represents, is not obtainable from any other lac insect and the individuals shown there represent a fair average. Taking one typical specimen and treating it with alkali, to indicate the thickly chitinised structures, we get the picture shown in Fig. 4. It would be given by a specimen such as Fig. 3 a, represents. It is a pen and ink drawing of an insect seen more from its side. The ventral side, where the mouth is situated, is shown by the stylets of the proboscis, marked M, protruding. The dorsal side shows the anal tubercle (A.T.) and in front the spinoid tubercle (S.T.) and the brachial tubercles (B.T.) which form a pair attached to the upper spiracular openings, one of these being seen at the base of the brachial tubercle as a round hole.

One feature of *Lakshadia mysorensis* is its restricted choice of host. It is so fond of *Shorea talura* that practically no other tree competes with it. Samples of stick lac, when sectioned, would give a picture as in Fig. 2, which shows the twig of *Shorea talura* after it had long been preserved in a museum. Repeated attempts to infect other trees with the brood of *Lakshadia mysorensis* have shown that the insect can grow on a few other plants also (4) but even then the range is much more restricted than is true of other species. One herb, *Rhyncosia cana* D.C., was found naturally infected at the end of a monsoon season. The entire plant was not over two feet in height and was removed into a pot for being photographed (Fig. 5). The length shown here represents about 4 inches height of the original plant. The encrustation eventually produced young larvae showing that it was otherwise quite healthy. But although the insects had settled all around the base of the plant they did not completely envelope it as is normally the case in *Shorea talura*. The plant *R. cana* is quite a common herb in Bangalore, more so in the plantation where *Shorea talura* trees are exploited for lac cultivation. Nevertheless all attempts to introduce lac experimentally on this herb completely failed, indicating that a predisposition of the tree to lac infection is necessary. This phenomenon is not very obvious but nevertheless important, as has been explained before (5). If lac is produced accidentally on one plant it does not mean that other individuals of the same host, even in the same locality, would do so, notwithstanding a conclusion often mentioned in the literature. This particular plant was finally

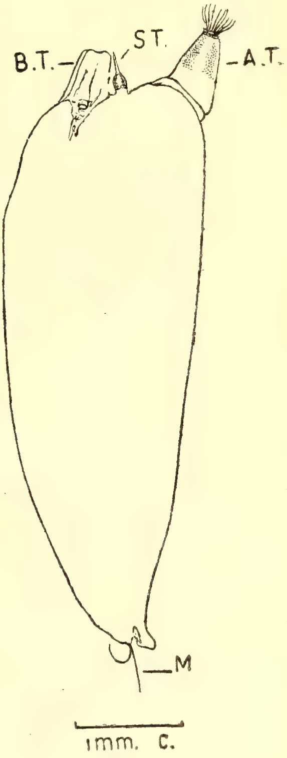

Fig. 4.

uprooted when it was found to be attacked by termites and in a condition which would hardly be called healthy. This again is an observation not in harmony with the classical views on lac cultivation.

SUMMARY

Lakshadia mysorensis is the smallest lac insect growing, for all practical purposes, only on *Shorea talura*. Its stick lac, when sectioned, reveals specific features, particularly small sized insects, long and elliptical in shape. An instance is recorded of its rare infection on *Rhyncosia cana* which could not be made to bear the infection experimentally.

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EXPLANATION OF FIGURES

Fig. 1. *Lakshadia mysorensis* on *Shorea talura*, monsoon season, Bangalore. Cross section of a twig growing vertically but not ideally so. The side marked V, ventral, was slightly inclined to the earth where the growth of wood and of lac insects is better than that shown on the opposite, or dorsal side, D. Insect marked 'a' is typical, long and short bodied individual. The empty cell 'b' is also characteristic of this species. Magnification 38 : 10.

Fig. 2. Cross-section of stick lac of *Lakshadia mysorensis* on *Shorea talura* represented by a vertical twig and thus comparable with that shown in Fig. 1. It was probably collected in the monsoon season of 1900 and was deposited at Bangalore in 1901, Magnification 38 : 10.

Fig. 3. *Lakshadia mysorensis* all insects, excepting one, freed from all secretion after treating stick lac with alcohol. Magnification less than 3 diameters.

Fig. 4. *Lakshadia mysorensis*, full grown female, with a typical elongated body and narrow diameter. A.T. = Anal Tubercle ; S.T. = Spinoid Tubercle ; B.T. = Brachial Tubercle ; M = Mouth parts protruding.

Fig. 5. *Rhyncosia cana*, infected with *Lakshadia mysorensis*. The length seen here represents a height of about 9 inches.

THE LESSER FLORICAN [*SYPHEOTIDES INDICA* (MILLER)]:

ITS COURTSHIP DISPLAY, BEHAVIOUR, AND HABITS.

BY

K. S. DHARMAKUMARSINHJI

(*With a plate and 2 text figures*)

SYNOPSIS

This paper contains descriptions of the male florican's courtship display (as newly seen) in presence of the female, mating, the method of snaring florican with decoys, the male's aggressive behaviour towards a male decoy, and some useful information as regards migration, and the influence of weather upon the species in its breeding habitat.

Various ornithologists and sportsmen have written on the courtship display of the Lesser Florican. They have described the display of the male as commonly seen. I have tried to add to this, describing the whole display in detail. My field observations on the display of the male have been supplemented by a semi-slow motion cine film in which the action of the entire nuptial flight can be seen clearly. Some writers suggest that the female florican also displays in the manner of the male. The majority agree, however, that it is the male alone that does so and with this I concur.

I have also described in this paper the aggressive pose and method of attack of the male towards rivals. These studies were made in the field when engaged in banding floricans for a number of years in catching which, stuffed male decoys were employed. The male's courtship display and sexual behaviour were studied with the help of a stuffed female decoy.

As regards the voice, feeding, nesting, and parental habits, I have quoted the observations of others as well as given my own. A connection between the male's display and internal and external stimuli is suggested.

Studies on the florican's methods of escape from predators were made by using falcons trained to catch these birds. It is concluded that Man with his gun and snares is the most serious menace to the species.

Data on migration have been obtained by observational methods and also from banded birds.

COURTSHIP AND DISPLAY

The peculiar courtship display of the Lesser Florican has attracted much attention from sportsmen and ornithologists alike, and the accounts of the display differ little. Most writers refer mainly to the display of the male, but there is some reference e.g. by Wenden and Stuart Baker, to the female also displaying in a similar manner.

Oates (Nests and Eggs of Indian Birds: 382) quotes Lieut. F. Alexander as follows:

> 'The mating season commences at the close of August or the beginning of September at which time the male bird commences to jump in the grass; this jumping is almost entirely confined to the male bird, and ceases as soon as the mating season is over . . . . as the act of jumping is always accompanied by a call (very like a frog's croak) and they can be followed thereby.'

By using the word 'almost', the writer implies that the female may also occasionally display in the manner of the male.

In none of the published descriptions do we get a detailed account of the courtship display, but most writers agree that it is only the male that displays to attract a female or to challenge a rival male. As regards the female displaying in a similar manner to the male, much is left in doubt. It is well known that at the commencement of the breeding season (chiefly June and July, but depending much upon the rains), the male florican assumes a conspicuous black and white nuptial plumage in which some strikingly elongated feathers (three on each side) situated just under the ear are visible, but I shall not speculate on what their true significance may be. The general impression gained of the male in his courtship display is that he springs perpendicularly upward emitting a frog-like croak and then falls downward to the spot from where he commenced. This performance is repeated almost regularly at intervals of three or more minutes irrespective of whether a female is present or not. Nevertheless, it seems desirable to give a more detailed explanation of the display itself. The male birds behave in this characteristic manner while in their established territories or while still in the process of acquiring them. Before he commences on his leap, the male usually stretches up his neck to take a full view of the surrounding country-side and often looks or turns around to make sure that there is no danger lurking, or to listen to or watch a rival bird displaying. In fact, the stretching of his neck and body to its full height is a sure sign of his being about to commence upon his leap. (This can only be seen when the bird is in short grass or crops). He bends his legs and springs perpendicularly into the air, the wings helping him to reach the climax of the leap. When at the zenith he arches his neck and almost rests it on his back, and emits the frog-like croak. His wings, which are partially outstretched and almost horizontal to the body, rapidly beat the air. At this moment the legs are pulled in as in a sitting posture. The bird then falls straight downward keeping his wings loosely at his sides thus often breaking his speed. Finn aptly describes this as 'parachute-fashion'. During descent, the legs, as a rule, are semi-outstretched and are often moved alternately in order to maintain balance. The bird lands at the same spot from where it had commenced its leap. The whole display is a rapid performance carried out in a matter of seconds. The height of the leap which may be about four to six feet, does not seem to vary much; in fact it is surprising how accurately the same height is attained at each jump. The whole display may be broken up into three phases: first, the upward leap; second, the climax which includes arched neck, rapid fluttering of wings, and call; third, downward descent. The overall time taken is about four seconds. The interval between each display depends on internal and external stimuli such as weather, breeding condition of the individual, presence of a rival male in sight or within hearing distance, and the presence of a female in view or otherwise. Normally, there is no doubt that the birds display regularly during the early mornings (before dawn until about an hour after sunrise) and again in the evenings before sundown to after sunset. Birds which are suspicious of lurking danger or in close proximity of human beings or cattle tend to display less persistently. Moreover, when the breeding season is on the wane, the calls become weaker in intensity, and the display is seen in an irregular manner.

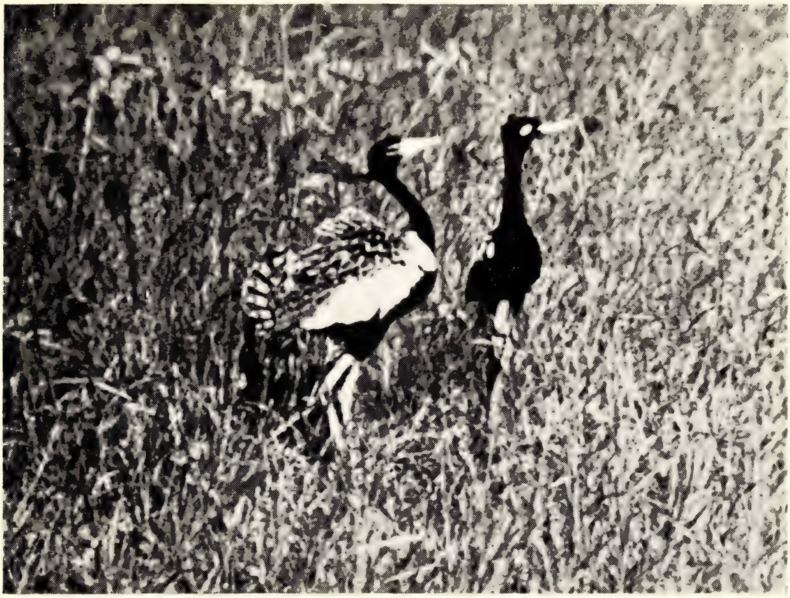
The weather influences the birds' display to a great extent. I have constantly seen birds displaying throughout on cloudy days and when there are short breaks of clear weather in the monsoon season. In contrast to this, when a long stretch of dry weather intervenes, the birds seem to call only during the early mornings and late evenings. They are attracted to areas where the monsoon has broken early and the rainfall is good. From where it is scanty and insufficient, birds tend to emigrate into areas where grass and other vegetation sprout quickly. With a favourable monsoon, and easy availability of food, the birds soon begin to occupy territories and to display. In rare cases and where food is plentiful, one may see a bird which has not yet assumed its nuptial plumage, or only partially, displaying even before the first rainfall. I have noticed this in places where there was an outburst of grasshoppers and locusts. It thus happens that in areas where the monsoon has been early and food is plentiful, birds tend to commence their display earlier than elsewhere. Here the displays also wane earlier than in areas where rainfall is late. In an abnormally late monsoon, birds may commence to display at the end of August and even the beginning of September, whereas, in a normal monsoon, when the rains break after the 15th of June to the first week of July, birds commence to display at the end of July. I have known birds to arrive in certain districts and begin calling as late as end of September. However, before the grass is sufficiently tall to give concealment, they do not commence to call but seek cover of vegetation or old grass such as grass-hedges or 'shedhas' and scrub-jungle. On the whole, the birds prefer areas where there is a more constant rainfall, in which food and cover are easily available.

Waxing and Waning Periods

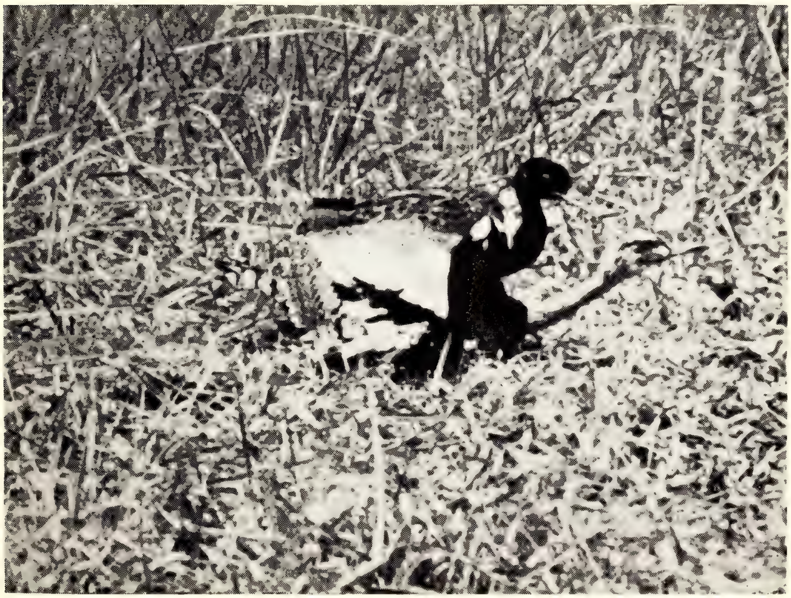
What I consider the waxing period of the male's display, though to a certain extent it varies individually, is, from the time the male bird commences to display and has either occupied or is in the process of occupying his territory, to the time when the crops and grass are high at the end of the monsoon. The waxing period is often signalized by the male flying up into the air at almost sixty degrees, with a flutter of wings, emitting his frog-like croak, corresponding to his characteristic display, when flushed by human approach. This behaviour is usually seen at the beginning of the waxing period when he is at the height of his pugnacity. However, all individuals do not react in this way. The sign of the waning period is when the birds are inclined to display irregularly and at long intervals when also the voice loses its intensity. The waxing and waning periods are influenced by the monsoon to a great extent. Individual birds, may have their waxing or waning periods in various stages, depending upon internal or external stimuli, so that one male bird may be in a waxing condition of the display whereas in a neighbour the display may be on the wane. This, however, is not the normal case in one and the same area but may occur where one district has had early and continuous rainfall while in another rain has been scanty, delayed or irregular.

If disturbed while displaying in his favourite spot, a male bird may move off some distance and begin displaying from there. He may also display while walking from one place to another or while feeding, but he will not leave his established territory as a whole. The favourite displaying ground or 'arena', known to the Bhavnagar Bhall trappers as the 'akhali', may vary in area from 50 × 50 yards to almost 4 ft. square, or less. This 'arena' is regularly resorted to by the male bird, and by his constant jumping the grass becomes trampled and the ground often stamped bare. The birds often choose natural open spaces for their 'akhalies' which are sometimes indicated by their excreta. The local trappers believe that the male bird will continuously display in their 'akhalies' once they have established their territory. This may be true to some extent since the birds are often snared on their 'akhalies', but it is not so in all cases. I have, however, observed that where the grass is close, high and extensive with only rare open patches, the birds resort more regularly and constantly to their favourite 'akhalies', especially in flat country. The birds prefer raised ground for their displays, from where they can get a better view of the surrounding countryside and from where their calls can carry longer distances. Also in order that the display may be seen clearly by rival males and eligible females alike from a long way off. A stream or a ravine, or perhaps a road, may act as a barrier between the territory of two rival males, and I have often seen two birds displaying vigorously and challenging each other from across, not very far away. Owing to the preference of displaying cocks to show themselves off, they frequently step out into either short grass or low crops. Thus the birds are often seen displaying in the recumbent ground-nut crop for which they appear to have a special liking. In such places the regular 'akhalies' or arenas are rarely met with, though the birds are often attached to one particular field or small area.

With regard to external stimuli which play an important part in the active display of the bird, I have noticed that although a male bird may display regularly irrespective of whether another male is within hearing distance or not, there is no doubt that the presence of a rival in the neighbourhood has a stimulating effect on him. In fact, experimenting on this, I have caused birds to commence calling by smartly clapping on the under-side of the fingers of my hands, in imitation of the call of a rival male, and have thus kept male birds calling continuously for some time. The presence of a female flying low in the vicinity of many male birds has a very stimulating effect on them. A female bird flying over an area sets off the males displaying almost simultaneously, when just a moment before none were



Male Florican in angry pose, with male decoy.



Photos *K. S. Dharmakumarsinhji.*

Male Florican mating on female decoy.
(Note position of auricular feathers).

so engaged. The whistling call of the female also attracts the attention of the male. The trappers, knowing this, imitate the whistle of the female to locate a male bird which has been lying low. The male responds immediately by stretching his neck above the grass in anticipation of seeing the female, thus betraying his position. I have tried this method but have not found it very successful.

The male birds have been known to display silently without their characteristic frog-like croak. I have noticed this in a number of birds and the reason seems obscure. But birds which have been hunted fairly often display without calling, especially when suspicious, though I have observed some birds displaying silently when I was clearly visible and which apparently were quite unsuspecting. I have also seen a male bird displaying, calling once and then not calling at the next jump. The birds sometimes also call without leaping. This is usually during the hot time of the day when they are reluctant to rise, or where they have been persecuted on their displaying grounds. However, there may be much uncertainty about the sexes and ages of these unseen birds since I have known females to call while concealed in the grass, in identical manner. If one listens carefully to different birds calling, one can often discriminate in the tone and volume of individual birds; some have a comparatively shriller voice, in others it is deep and more resonant. I have not yet ascertained whether it is the younger birds which have the shriller voice, but some birds shot while emitting the shriller call, were those that had not assumed a complete black head, and still showed traces of brown feathers.

With regard to the display of the female, in similar manner to that of the male, Mr. Stuart Baker (Game Birds of India, Burma and Ceylon, 2: 206-7) quotes Mr. Wenden as follows:

> 'On the 16th I went out and watched this bird for more than an hour, just about the time at which she had been flushed, on the morning before, from the single egg. From the tree on which I sat, with my binoculars, I saw her running rapidly out of the dense preserve, across the open and into the scanty patch in which was her egg. Here she moved about for some minutes feeding and every now and then sprang into the air with a low clucking cry which was answered by the male bird from the preserve, though at first sight I could not see him. Then, as though a sudden thought had struck her, she darted to the nest and after one or two springs and walking round and round the egg, she squatted and deposited another. While she sat she was silent, but the male bird who had now advanced closer to me, kept springing in the air and crying continually. The operation of laying of the egg seemed to last about twenty minutes, i.e. from the time she sat to the time she rose, and having made another spring or two walked around the eggs; she then made straight tracks for the dense grass where the male bird was calling. I went out quite alone on this watching expedition and all was quite quiet, and the birds were at their ease, but while I was still in the tree a man came into the preserve with some cattle, and then I saw both birds spring several times *silently* and after that I saw or heard nothing of them.'

From this account it would appear that the female definitely displays in a similar manner to the male, and Mr. Stuart Baker (*ibid*: 206) comments as follows:

> 'Allusion has already been made to the curious habit displayed by this bird of jumping into the air, to some height above the surrounding vegetation, in order to attract the notice of the opposite sex. Generally, it is the male alone that resorts to this trick, but sometimes, at all events, the female also does indulge in it.'

Personally I do not believe that the female displays in the manner described of the male, and although I have sometimes seen female birds springing up above the grass and in the crops, I ascribe these jumps to feeding activity, corroborating Hume—(quoted by Mr. Stuart Baker, *op. cit.* 2: 206-7) that, 'this is only for the purpose of catching flies, etc. as they are disturbed from the grass.'

COURTSHIP OF MALE

So far I have described the male's nuptial display and nothing has been said regarding the behaviour of the male in the presence of the female. It is quite possible to miss seeing this phase owing to the wariness and the secretive habits of the females. Except when a female wishes to mate with a male, the sexes rarely, if at all, come together. I have occasionally watched female birds alighting next to a displaying male and have only once flushed them together. In order to witness the reactions of the male bird in the presence of a female, I placed a stuffed female decoy close to where a male was displaying—regularly. The result was very interesting and successful; for the first time I witnessed an entirely new courtship display of the male, which has never been described before. The male, having become conscious of the female decoy's presence within a yard or two of him, immediately craned his neck forward to its full extent. Raising his forehead and chin feathers and slightly inflating his pouch, he moved towards the decoy, swaying his stiff neck from side to side, arching it slightly in a characteristic manner. (Fig. 1.) Then, he stopped suddenly and jerked it backwards to rest it almost on his back, at the same

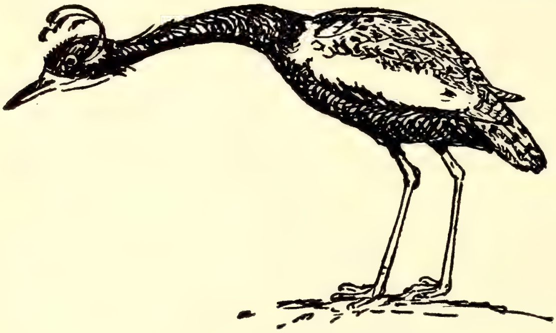


Fig. 1.

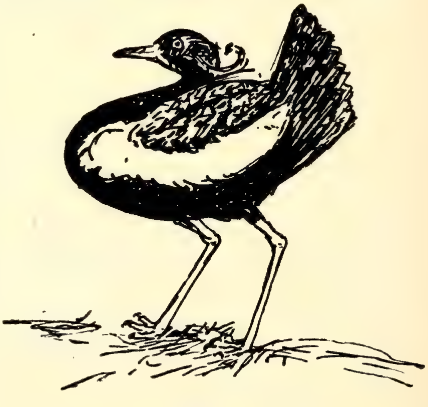


Fig. 2.

time emitting a low wheezy croak. (This wheezy croak is not always heard or emitted.) He did this twice in front of the decoy, on both occasions clearly showing the characteristic arching of his neck prior to jerking it backwards. In this act, the head and particularly the black chin feathers were raised and the tail was depressed. Following this courtship, the male attempted to mate with the decoy. But because the female was not in an appropriate position for mating, the male stepped over the decoy from the posterior side and could only make vain attempts, often pecking at her head. Finally, he worked himself up to such a pitch of excitement that he sat down on his tarsus, beside the decoy with his wing stretched out over it in a position of mating, reminiscent of a turkey in the act of copulation. This characteristic courtship is so strikingly different from the usual leaping displays that it is worthy of record. Further experiments on the same lines revealed that the full courtship was not gone through in all cases, although the male invariably stretched out his neck arching it in the characteristic manner, puffing out his forehead, crown and chin feathers while approaching the decoy. Along with this, another aspect of the courtship was also seen in which the male bird, while pressing the neck backwards and resting it on his back with the head and bill pressed in slightly downwards, spread out his tail-feathers fanwise. (Fig. 2.) His posterior was slightly raised while the neck rested almost on the back, and the body swayed lightly to and fro. Here then are two types of courtship proceedings seen in the presence of the female, of which the former is unique, while the latter resembles the aggressive pose of the male.

MATING OF MALE BIRD WITH FEMALE DECOY

When a female decoy is placed in an attitude conducive to mating, the male bird, invariably copulates with her. But in cases where the female decoy is not appropriately poised, the male invariably pecks at the head and makes vain attempts at mounting. It appears from these studies that the female must sit down and spread her shoulders in order to allow the male to copulate successfully. During copulation, the male bird balances himself on his tarsi, his feet resting on the back and wing-shoulders. This I found to be, to a certain extent, necessary for the male in order to maintain his position while in the act. The head and neck are slightly drawn and somewhat raised and are kept in this position. The wings droop on both sides of the decoy.

AGGRESSIVENESS OF MALE

It is well-known that the males, during the breeding season, guard their established territories against rival males pugnaciously, and Jerdon (Birds of India, 3: 624), writes:

> 'This (jumping and croaking display) is probably intended to attract the females who, before their eggs are laid, wander greatly; or perhaps to summon a rival cock, for I have seen two in such desperate fight as to allow me to approach within thirty yards before they ceased their battle.'

In order to witness the fighting pose and behaviour of the male when in his own territory, towards an encroaching rival, it is only necessary to introduce a stuffed male decoy in a position from where the owner can see it. I have tried this experiment very frequently, in order to catch male birds for banding. The best situation for introducing the decoy is where a male displays regularly, i.e. at his 'akhali', but he can also be easily attracted away from this spot if it is placed within reasonably seeing distance from him. After placing a decoy in position, the observer must withdraw some distance away from the calling bird and the decoy, since the males are sometimes very wary if he is not well hidden. The male bird may not always perceive the decoy's presence immediately, but it is surprising how quickly he usually does detect it inspite of its immobility. The invariable sign of a male bird having detected the decoy is that

TABLE 'A'

Showing reactions of male towards female decoy

SPECIMEN No.	DATES	POSE OF FEMALE DECOY	COURTSHIP OF MALE	MATING
A	9–9–49	Head and neck arched, wings close to sides.	Complete.	No.
B	11–9–49	Head and neck outstretched, wings and shoulders close to sides.	,,	,,
C	11–9–49	,, ,, ,,	,,	,,
D	14–9–49	Neck outstretched, wings and shoulders slightly apart, and the female decoy fixed close to ground.	Incomplete.	Yes.
*D	14–9–49	,, ,, ,,	,, ,,	,,
E	14–9–49	,, ,, ,,	,, ,,	,,
F	16–9–49	,, ,, ,,	,, ,,	No.

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* The same male mated twice within a few hours.

he immediately stops displaying. If the observer remains quiet he will presently see him advancing towards the decoy. He usually creeps up towards it, making use of the best cover possible and raising his head from time to time, possibly to look out for danger or to see whether the rival bird has moved. If the male does not suspect any danger, he moves quickly up towards the decoy and gets there in a very short time. A few yards from the decoy he becomes more cautious, and finding the rival completely motionless, he does not always attack immediately. At this time a sudden anger coupled with diffidence seems to come upon him and he turns his back to the decoy, with tail and upper feathers raised. He may remain in this position for even upto 15 minutes sitting down or moving but slightly. Then, as is invariably the case, he suddenly seems to gather courage and vigorously turns upon the male decoy, pecking at its head with his sharp pointed bill, the feathers of his back and scapular raised and his tail erected. The onslaught on the decoy is usually from the rear, but in his attempts to overcome the 'rival', he is seen to attack from all sides as well. If the decoy is placed slightly above his reach, he makes no hesitation in leaping on to it to reach the head, the legs often hitting the decoy. The attack of the male ceases temporarily after the first bout but is presently resumed until he either gets tired and loses self-confidence or, until the decoy is knocked down. When a decoy has fallen to the ground, he still continues to peck at it for a short while, his tail feathers still being raised and often spread-out. Occasionally, one may see a male bird coming to the attack on the run with wings spread out, reminiscent of the Sun-bittern in display, but this is unusual. During the attack the eyes, sides of the head and nape of the decoy are the main targets, and even though the decoy may not have any eyes, he is still seen to concentrate his jabs on the place where the eyes should have been. I have seen a bird swallow pieces of cotton wool stuffed in the head of a decoy, and also remove the whole head of an old decoy by repeatedly attacking it. Towards the waning period of the breeding season, males do not attack a decoy so readily; therefore at that period it is seldom that the birds can be snared, by this method. During the waxing period, however, the males are so pugnacious that several birds may be caught at the decoy in one morning. Moreover, it is interesting to note that I have re-captured the same male bird on the same decoy, on the same day, after it had once been caught and released. There is no doubt that the aggressive pose of the male is when the feathers of the upper parts are raised, wings slightly drooped at the shoulders, and the neck arched and resting on the back. Inspite of this species being so shy of man, it is surprising how male birds caught during the waxing period, if held opposite to each other even soon after capture, will show their pugnacity by pecking at each other's heads. When attacking a male decoy, a bird sometimes becomes so engrossed as to allow close approach. Besides, a bird vigorously attacking a decoy around which snares have been set, may continue to do so blindly even though one of his legs has got caught in a noose. He often does not realise his captive state until he decides to move away. Then, suspecting that his trapped leg is the decoy's doing, he will suddenly turn round and resume his attack on it.

VOICE

Male: Apart from the frog-like croak that the male emits during the display, he utters a short whistle-like call when frightened—also heard when captive birds are released. I have also heard a wheezy croak uttered during the courtship display in the presence of a female decoy but this is not always the case; it is emitted at the time when the male suddenly throws his head backwards. As mentioned earlier, birds may vary individually in their tone and volume which again may depend on age or waxing and waning periods.

Female: The female utters a croak resembling that of the male during his display, but slightly shriller. There can be much confusion in the male and female calls if heard in the grass or crops. She also has another call which can be syllabilised as 'Peeoo'. This is a whistle which appears to attract the attention of the male, and, as mentioned earlier, is imitated by the trappers. She has another clucking call or quirk which she emits when put off her nest, and a similar note reminiscent of Nukhta (*Sarkidiornis melanotos*), which can be heard at times when she is flying. In general, it can be said that the voice of either sex is not often heard except in special circumstances, and that the frog-like call of the male during the display is the most characteristic one.

It is interesting to compare the above personal observations with those of others. Mr. Stuart Baker, (Game Birds of India, 2: 214) wrote as follows:

> 'The voice of Lesser Florican during the breeding season, is said to be a harsh croak, this being indulged in by the bird during its nuptial flights. The voice of the hen at this time is described by Wenden as "a low clucking cry", but whether this differs from that of the male or not he does not say. According to Jerdon "it is said to have a feeble plaintive chirp or piping note when running or feeding", and he also says that "when flushed it utters a kind of sharp quirk or note of alarm". A personal friend of mine who has spent much time in watching these birds, gives them credit for a rather large vocabulary. He remarks *in epistola*, "These Floricans have many notes besides the drum or croak they give vent to in the breeding-season. When moving about feeding they constantly utter a low chuckle and also the chirp or piping note referred to by Jerdon. Males and females also call to one another in a croak like that just mentioned, but softer and lower".

With reference to the last statement, I can well believe males and females calling to each other in a croak-like manner, but I have never heard them constantly utter a low chuckle while feeding.

SOCIAL BEHAVIOUR

As regards the social behaviour of Florican, I am inclined to agree with what Stuart Baker writes in his 'Nidification of Birds of the Indian Empire' (4: 335-6), that it is indiscriminate in its love affairs. Males are certainly not polygamous in the sense of having a bevy of wives which keep to him throughout the season. Nevertheless, a male may mate with one or more females during the season. Likewise, a female may be mated to one or more males until fertilised.

But on this point further evidence is required, and experiments need be carried out scientifically.

Migration

We know that the Lesser Florican is a local migrant in India, and breeds wherever conditions are favourable for it. In Kathiawad, it is a regular immigrant from the Indian mainland, and birds arrive from the end of May, June and July to August. I have often seen many birds arriving a few weeks before the monsoon had broken in Kathiawad, and which were still in their post-nuptial (non-breeding) plumage. Some individuals, however, had assumed their black dress and were beginning to show their auricular plumes. At this time the birds seek cover of dry grass and hedges and resort to babul thickets. Most of them, however, take protection of extensive dry grasslands, and they may be seen moving here and there almost aimlessly in fields and across the roads. I am inclined to believe that as soon as the heavy rains break in South and Central India the birds tend to migrate northwards and westwards, respectively. By observational methods I can say that the birds cross the Gulf of Cambay and first touch the east and south-eastern coast of the Kathiawad peninsula from the direction of Gujarat and Bombay. From here they spread to all parts of Kathiawad. Birds may be seen arriving in heavy rainfall, and they tend to follow the course of the main current. If there is insufficient rainfall in one area then the birds migrate into adjacent areas where the rainfall is better. This immigration has been well recorded by birds shot and seen from Botad to Port Albert Victor all along the eastern Kathiawad coast-line. It may be safely said that birds migrating into Kathiawad follow a direction from south-east and east to north-west and west.

The birds remain in Kathiawad throughout the breeding season. Some have been recorded crossing the Gulf of Cambay towards Gujarat after the harvest of the monsoon crops in October. But, there is insufficient data on this. To obtain proper information, birds should be recorded arriving on the opposite coast-line in Gujarat. This return migration takes place about October-November. Some birds remain in Kathiawad during the winter months in cover of wheat crops, but the majority, I believe, emigrate to the mainland. Birds banded in Kathiawad during the breeding season have been recaptured in the same general area the following or in subsequent breeding seasons, but there is no tangible evidence of the banded birds having returned to the mainland in the interval. Some birds—mostly solitary females—have been recorded in the hot season, and these may be stay-backs. Evidence from banded birds reveals that florican are not particular about returning to the same areas for breeding in which they did the previous year, though we have had some such recoveries. (See Table 'B').

The banding scheme of His Highness the Maharaja Saheb of Bhavnagar, carried out by me from 1943 to 1947 gives us the following data.[1]

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[1] K. S. Dharmakumarsinhji (1943): Banding of Lesser Florican in Kathiawar, *Journal, Bom. Nat. Hist. Soc.*, 44, 2: 299.

TABLE 'B'

RECOVERIES OF LESSER FLORICAN BANDED IN BHAVNAGAR. (KATHIAWAD).*

RING NO.	DATE OF RINGING	PLACE OF RINGING	DATE OF RECOVERY	PLACE OF RECOVERY
BF 5	23–7–43	Mithapur, (Bhall) (Gohilwad).	29–7–44	Badudi, Bhall (Gohilwad)
BF 67	15–8–43	Badhada	30–7–44	Badudi, Bhall (Gohilwad)
BF 68	25–8–43	Malankun, (Gohilwad).	28–8–43	Malankun
BHF 93	7–9–44	Trapaj	8–7–46	Velavadar, Bhall
BHF 94	7–9–44	Trapaj	8–7–46	Velavadar, Bhall
BHF 95	7–9–44	Gadhada near Trapaj	4–8–47	Bhall
BHF 124	28–7–45	Mithapur, (Bhall).	12–7–46	Mithapur, (Bhall)
BHF 205	27–8–45	Sathara near Trapaj	15–8–49	Mithapur, (Bhall)
BHF 207	27–8–45	Sathara near Trapaj	6–8–47	Mithapur, (Bhall)
BHF 229	12–7–46	Mithapur, (Bhall)	18–7–47	Halor Dist., 8 miles east of Rajkot
BHF 232	12–7–46	Mithapur, (Bhall)	5–8–47	Bhall area

TABLE 'B'—(*cont.*)

RING NO.	DATE OF RINGING	PLACE OF RINGING	DATE OF RECOVERY	PLACE OF RECOVERY
BHF 236	12–7–46	Mithapur, (Bhall)	7–8–47	Mithapur, (Bhall)
BHF 237	12–7–46	Mithapur, (Bhall)	7–8–47	Mithapur, (Bhall)
BHF 248	14–7–46	Mithapur, (Bhall)	7–8–47	Mithapur, (Bhall)
BHF 251	18–7–46	Palania vid. (Gohilwad)	16–8–46	Palania vid.
BHF 281	29–8–46	Allapur near Hathab (Gohilwad).	23–8–47	Allapur near Hathab
BHF 295	7–9–46	Trapaj (Gohilwad).	5–8–47	Bhall
BHF 343	6–8–47	Bhall area, (Gohilwad).	15–8–49	Mithapur, (Bhall)
* BHF 391	16–8–49	Mithapur, (Bhall)	14–7–50	Baroda

From 22-7-43 to 24-9-43, one hundred male floricans were banded, out of which two were recovered the next year. One of these was caught in the same district as it was formerly ringed in. A bird banded on 25-8-43, with number BF 68, was found dead three days later in the same area. From 27-7-44 to 8-9-44, ninety-nine male floricans were caught and banded. In 1945, from 20-7-45 to 1-10-45, one hundred and eleven males and one female were banded, but none have been recovered. In 1946, one hundred floricans were banded, all of which were males. In this season, four birds were recovered of which two were in the same locality as banded (for details see table). In 1947, sixty-seven male birds were banded between 25-7-47 to 24-9-47. Nine birds were recovered of which seven were of the previous year, one was of 1944, and one of 1945. Of these, five birds were recovered from the same respective 'vids' first caught. In 1948, it was a famine year and no birds were caught although some were seen as passing migrants. In 1949, I managed to catch eleven males out of which two proved to be birds banded in 1945 and 1947. One of these was caught from the same area where it was first ringed two years earlier. Altogether four-hundred and eighty-nine birds were ringed in seven years of which eighteen were recovered, giving an average recovery of 3·6%. (See Table 'B'.) It is quite possible that some of the banded birds are caught by poachers, and useful information thus lost.

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* This record was received when the paper was in the press. The author wishes to draw attention to the fact that this is the first record of a ringed bird obtained outside Kathiawad. He suggests that the bird was about to cross the Gulf on its westward journey to its breeding grounds.

It is desirable to recover ringed birds during the non-breeding season in order to understand the direction and goal of their migrations. When migrating, florican fly singly, but during this period a number of birds may be seen scattered close to one another. During migration, the birds do not seem to fly very high. I have no evidence of the female arriving on their breeding grounds earlier than the males, but there is no doubt that early in the season they are seen more frequently than later on. Once the grass has grown and the crops are up, it is difficult to locate the hens. When the birds first arrive, they may be seen in completely open ground and are fairly conspicuous from a distance. The presence of birds in such open spaces usually indicates that they have recently arrived.

FLORICAN AND THEIR PREDATORS

From the time when the birds arrive (just before, and at the break of the monsoon), the birds may seem open to attack by predators, owing to the lack of cover at the time. But when the monsoon has broken, and the winds are strong, it is unlikely that any birds of prey feel tempted to attack them. Moreover, just before and after the monsoon breaks, birds of prey are surprisingly few. And the abundance of other birds and animal and insect-life at this time, would naturally supply sufficient food for the birds of prey and terrestrial predators. However, once there is plenty of vegetation, the birds may suffer from terrestrial predators, e.g. wild cats, jackals. But in all my experience, I have not seen or heard of instances of this kind (except one when a jackal caught a male that had been snared), nor have I seen remains of any florican having been killed by predators at this time of the year, though it is possible that an occasional bird may be surprised and killed. It may appear that the male, while displaying, would be particularly open to attack by predators but his good hearing, keen eye-sight, and method of escape on the ground usually provide effective protection. I have hunted male birds with falcons, and can testify that without the aid of men to flush the birds, it would have been practically impossible for the falcons to catch them. While having a falcon 'waiting on' I have many times, with ample beaters, gone over and over the same piece of grassland or crop without putting up a florican which had been properly marked down. This shows that it is almost impossible to flush a florican if it has decided to lie close. While out shooting these birds, I have noticed that they often move out of the way of the line of beaters by running across or in circles. I have also noticed that florican will readily fly only while the falcon is facing away while 'mounted' or 'waiting on' or when it has 'raked'[1], invariably flying against the wind—a definite handicap for the falcon if it has raked down-wind. One of the methods of escape for a florican, when it is hard-pressed by a falcon, is to drop itself into the grass or crop, and if still pursued, it will leap up to land a few yards further into cover again. If followed up, he may repeat the manoeuvre or fly away rapidly out of range of an immediate attack. The flight of the florican appears slow on account of its steady wing-beats but I have always underrated the speed. When pursued by a falcon, the bird does not always fly in a straight line, but in zigzags. But when hard pressed, they seem to put on extra speed by rapid wing-beats. On account of their stiff and pointed primaries, rain does not seem to hinder their progress and they can fly comfortably even in heavy rainfall. I have observed displaying birds for hours together but have never noticed a bird being flushed due to a predator's attack. Nevertheless, a dangerous period for the species appears to be during the breeding season when hen-birds are on their eggs or are rearing their young. This is a critical time for the hen-birds, but, what has been mentioned regarding cover, and food available to predators, and the wariness of the species, applies to her safety also. Yet, the most dangerous period seems to be just after the harvest when there is little cover and when hordes of different kinds of birds of prey are seen to be migrating and arriving in large numbers. This period commences in October and continues throughout the winter months. At this season, I have found the remains of floricans on the eastern Kathiawad sea-board, the birds obviously having been caught by Peregrine Falcons, while attempting to emigrate across the Gulf of Cambay. The greatest danger to the florican is the man with the gun and perhaps more so, the man with snares and nets. Hume and Marshall (Game Birds of India, Burma and Ceylon, 1: 36) write as follows:

> '*Pardis*, the professional poachers of the Deccan, snare them along with Partridges and Quail, simply by setting a rope of snares down the grassy bank of a dry "nala" and then beating the bushes.'

It is with much reluctance that I have mentioned the method of attracting the florican with male decoys, a secret known by the Bhavnagar Bhall trappers since a very long time, not only because the method is so infallible during the breeding season, but because if used indiscriminately it would, no doubt, exterminate the species in a very short time.

FEEDING HABITS

Florican generally feed during the early mornings and evenings. However, when the birds have newly immigrated, at which time they are in a lean condition, they feed at all times of the day. During the breeding season, a male may be seen feeding and displaying alternately. The birds may be seen running to catch insect-life, and I have seen them jumping or springing up to catch insects which have been above their reach, or when flushed by them. However, they usually catch their prey by creeping up to it and then with a sudden thrust of the neck, catching with the sharp pointed bill very much in the manner of the Cattle-egret. Because of their habit of springing up to catch insects above their reach, some naturalists have mistakenly recorded females as displaying. Normally, when a male bird in breeding season is feeding, he stops calling the while; and he usually keeps to his own territory while feeding. Females, during the monsoon, feed anywhere, and are often seen close to marshes and swamps where they come to feed regularly. While feeding, the birds often raise their heads above cover to have a look round, and then resume. For feeding purposes they seem to prefer shorter grasses or low crops. With birds in captivity, kept in a large enclosure during the hot season with sparse grass and many fallen teak leaves, the birds were noticed to search for their natural food which was scanty. Their method is worth noting. The birds erected and spread out their tail fan-wise and with their necks arched, they moved slowly and deliberately, often swaying their body forwards jerkily as they stalked for the purpose of flushing insect life. It was observed that if an insect was flushed, the bird suddenly darted forwards to catch it. It was also found that males, in post-nuptial plumage, could tolerate each other in the same enclosure, although I never saw two birds feeding together at the same trough. This experimental enclosure was L-shaped and approximately 4600 sq. yards. The birds were fed on flour mixed with egg and liver. In their natural environment, florican feed on a great variety of insects but in captivity I have seen them feeding on plant seeds also.

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[1] A term in falconry for when a 'waiting on' falcon circles some distance away from the falconer.

In conclusion, I wish to mention that pending complete experiments as to their nesting and parental habits, I do not wish to say anything further except that the female, which is slightly the larger of the two sexes, nests on the ground in cover of either some bush or grass, generally preferring short grass for the purpose. As a rule, nests are not found close to each other, though I have seen a few nests in the same patch of grass and not far apart. The normal clutch is 4-5 eggs which vary in colour from brownish dark green, olive green, greenish brown to almost a greyish blue. Some eggs have darker markings. The young birds are reared entirely by the female. They have a distinct U-shaped mark on the neck near the throat.

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NOTES ON THE *LENTIBULARIACEAE* OF BOMBAY

BY

H. SANTAPAU, S.J., F.L.S.

Among the recent papers on the family and in particular on *Utricularia*, much has been written on the morphology and physiology of the various species; the literature on the taxonomy of the family as a whole or of *Utricularia* in particular is rather scanty, the only paper dealing in a comprehensive manner with genera and species of the 'Utriculariaceae' being that of Benjamin, (1847). Of recent years Barnhart published an interesting paper on the 'Segregation of Genera in Lentibulariaceae', but unfortunately this author stopped at this one paper, at least as far as I have been able to trace in Kew Herbarium and Library. A monograph on the family or at least on the genus *Utricularia* is long overdue; but we may have to wait still for many years before such work is undertaken.

The genus *Utricularia* is a very difficult one to deal with and to study in herbaria; most of the specimens are rather imperfect, as the leaves and stems are often omitted from the herbarium sheets; this may be due to carelessness on the part of the collectors, but often it is due to the fact that flowering takes place either before or after the appearance of the leaves, and a leafy *Utricularia* is very difficult, not to say impossible, of identification in the absence of flowers and fruits.

It is greatly to be hoped that special care will be taken in the collection and preservation of specimens of this family, so that in time enough material may be gathered in our herbaria for the complete study of the genus *Utricularia.* If at the same time collectors take particular care to take down ample notes on the fresh plants, their habitats, associations, etc., there is hope that satisfactory work may be done on this interesting and intriguing group of monsoon plants.

UTRICULARIA

1. **Utricularia stellaris** Linn. f., Suppl. 86, 1781; Clarke, in Hook. f., Fl. Brit. Ind. 4: 328, 1884; Graham, Cat. 165; Wight, Icon. t. 1567; Dalz. & Gibs., Bomb. Fl. 135; Oliver in Journ. Linn. Soc. 3: 174, 1859; Göbel, in Ann. Jard. Bot. Buitenz. 9: 89-91, f. 122, 1890; Kamienski, in Engl. Pflanzenfam. 4 (3b): 112, f. 47E, 1895; Cooke, 2: 316; Gamble, Fl. Madr. 980; Pellegrin, in Lecomte Fl. Gen. Indoch. 4: 470, 1930.

This is one of the commonest species of the genus found in Bombay; it is a water plant, seen often in tanks, with the flowers floating over the surface of the water. Typical of this species are the floats placed on the pedicel a little below the flowers; such floats seem to be transformed leaves, the float as such being the petiole of the leaf, the blade at times appearing as a bundle of filiform segments at the tip of the floats. The colour of the corolla is yellow.

2. **Utricularia flexuosa** Vahl, Enum. 1: 198, 1805; Clarke, 329; Oliver, 175; Gobel, 87–89, f. 101–105 & 115–117; Kamienski, 122; Cooke, 316; Merrill, Enum. Phil. Fl. Pl. 3: 466, 1923; Gamble, 980; Pellegrin, 471, f. 52 (1–2) & 53 (2).
Utricularia fasciculata Roxb., Fl. Ind. 1: 143, 1834; Wight, Icon. t. 1568.

In many respects this is very similar to *U. stellaris* Linn. f.; it floats in tanks and talaos, its flowers are also yellow; but it has no floats on the inflorescence peduncle.

3. **U. exoleta** R. Br., Prodr. 430, 1810; Clarke, 329; Cooke, 2: 317; Gōbel, 91–97, f. 106–114; Kamienski, 122; Gamble, 980; Merrill, Enum. Phil. Flow. Pla. 3: 466; Pellegrin, 473, f. 53(1).
Utricularia diantha Roem. and Schult., Syst., Mant. 1: 169, 1822; Wight, Icon. t. 1569; Oliver, 176.

This is also an aquatic plant growing in tanks, and in general very similar to the other two aquatic plants, but usually smaller. The most typical parts are the seeds which have a corky flat wing of about the same width as the seed is thick. A rare plant in Bombay.

4. **Utricularia albo-caerulea** Dalz. in Kew Journ. Bot. 3: 279, 1851; Clarke, 330; Dalz. and Gibs., 135; Oliver, 177; Cooke, 2: 317.

A terrestrial herb, growing in very damp soil or on wet rocks. Pedicels are recurved in fruit; the spur of the flower is rather stout and shorter than the lower petal. It is not a common plant.

5. **Utricularia arcuata** Wight, Icon. t. 1571, f. 1, 1850; Clarke, 330; Dalz. and Gibs., 136; Cooke, 2: 318; Gamble, 981.

One of the biggest-flowered species. It is a gregarious plant often seen growing on rocky ground, occasionally in grass fields at the height of the monsoon or towards the close of the rains; it requires a well-watered ground, at times it grows on almost water-logged ground. The colour of the corolla is generally of a striking purplish blue with a white spot at the base of the lower lip; occasionally the whole flower is white or uniformly salmon pink. As compared with other terrestrial species, the pedicels are also recurved in fruit, and the spur is about the most conspicuous feature of the flower, being falcately-curved and about as long as the lower lip. A common plant in Khandala, rare elsewhere.

6. **Utricularia uliginosa** Vahl., Enum. 1: 203, no. 25, 1805; Gamble, 981.
Utricularia affinis Wight, Icon. t. 1580, f. 1, 1850; Clarke, 330; Oliver, 178; Gōbel, 73–75, f. 19–21; Kamienski, 120; Cooke, 2: 318; Pellegrin, 479.
Utricularia brachypoda Wight, Icon. t. 1578, 1850; Oliver, 178.
Utricularia decipiens Dalz. in Kew Journ. Bot. 3: 279, 1851.

Terrestrial, growing often among grasses on grassy slopes; hence it is very difficult to collect the leaves of this plant, as they are almost embedded in the soil and mixed with various mosses and liverworts. I have often found it in Khandala in grass fields; pedicels are not recurved in fruit but erect; the lower sepal is said by Cooke to be entire and not 2-toothed, but most of the specimens which I have found in the field, and many of those kept at Kew show the notching of the apex of the lower sepal; both 2-toothed and entire sepals may be found on the same plant. The spur is short and almost straight, nearly conical.

7. **Utricularia graminifolia** Vahl., Enum. 1: 195, no. 3, 1805; Gamble, 981; Kew Herb. (1947).
Utricularia caerulea Clarke, 331; Oliver, 179; Cooke, 2: 318, et alior. auct. (non Linn.).
Utricularia pedicellata Wight, Icon. 1578, f. 2.
Utricularia uliginoides Wight, Icon. t. 1573.
Utricularia conferta Wight, Icon. t. 1575.
Utricularia purpurascens Graham, Cat. 165 (fide Cooke).

Typical of this species are the large leaves, about the largest undivided leaves of the genus in Western India. The lower sepals are said by Cooke to be 2-toothed, but this is not an exclusive characteristic of this species, as it occurs also in *U. uliginosa.* The pedicels are erect in fruit.

In the synonymy, attention is called to the fact that *U. caerulea* is the name given to this plant by Clarke, Cooke and others, but the plant is not the same as *U. caerulea* Linn. which is a valid name, see below. Comparing *U. graminifolia* with *U. caerulea* Linn. (non alior.), the differences between the two species are at one apparent: *U. graminifolia* has large leaves and a rather lax inflorescence which is composed of 6–8 flowers, each flower being on a rather long pedicel; whilst in *U. caerulea* Linn. the leaves are much smaller, the inflorescence in close racemes or spikes composed of a large number of flowers, the pedicels short or even O.

8. **Utricularia reticulata** Sm., Exot. Bot. 2: t. 119, 1805; Clarke, 331: Dalz. & Gibs., 135; Wight, Illust. t. 143; Oliver, 180; Cooke, 319; Gamble, 982; Góbel, 79–81, f. 80–83 & 86; Pellegrin, 477, f. 52 (5–6), & 53 (4 & 8–13); Kamienski 120.
Utricularia uliginosa Wight, Icon. t. 1574 (right hand figure only).
Utricularia graminifolia Graham, Cat. 165 (non Vahl).

The flowers of this species are the largest among Bombay *Utricularias*; the scape is filiform and up to 60 cms. long, generally twining among grasses, or in the absence of any support several scapes may entwine among themselves to form a many-stranded stout 'rope'. A gregarious herb, very showy and pretty when in full bloom; its flowering season is towards the end of the rains or shortly after them.

In Khandala, where the plant is abundant, the colour of the corolla is generally between 'Spectrum Violet' and 'Amethyst Violet' (Ridg. 59–61); the bullate process on the lower lip is white with a few purple lines; occasionally a flower is practically white.

9. **Utricularia reticulata** Sm. var. **parviflora** Santapau, var nov.

Accedit ad *U. reticulatam*, a qua tamen differt scapis floribus et fructibus saltem dimidio minoribus.

A bright flowered plant, a sort of miniature copy of *U. reticulata* Sm. Scapes from 6 to 12 cms. long, filiform; bracts and bracteoles as in the typical plant, but much smaller; pedicels filiform, up to 9 mm. long and winged in the upper part in fruit; calyx in flower 2–2·5 mm. long, broadly ovate, upper sepal slightly larger than the lower, both acute; in fruit the sepals enlarge to 6 x 4 mm. Corolla 6–8 mm. in diameter, the lower lip with a small bullate process of the same structure and colour as in the typical plant; capsules about 3–3·5 mm.

A gregarious plant growing in association with various grasses, and other plants (*Linum mysorense*, *Oldenlandia* sp., *Eriocaulon* sp. etc.). This plant has only been observed once in Khandala, on 31 Oct. 1944 (Santapau 5422) on Behran's Plateau; it was growing near, but scarcely mixed with, *Utricularia reticulata* Sm.; it can scarcely be said that the small size of the whole plant is due to ecological conditions different from those in which the larger plant grows, for when found the smaller plants were growing on the same sort of soil, and had about the same amount of water as the typical plant; at that particular spot there were two large patches of these two varieties, there being but little intermixing at the point where the two patches met.

10. **Utricularia caerulea** Linn., Sp. Pl. 18, 1753; Gamble, 983; Stapf in MS. in Kew Herb. (non Clarke, nec Cooke, nec alior. plur auct.)

Utricularia nivea Vahl, Enum. 1 : 203, 1805; Wight, Icon. t. 1582; Oliver, 186; Cooke, 319; Merrill, Enum. Phil. Fl. Pl. 3 : 466.

Utricularia racemosa Wall. Cat. 1496; Clarke, 333; Pellegrin, 485.

For the differences between this plant and *U. caerulea* Clarke see above under *U. graminifolia*.

11. **Utricularia striatula** Sm. in Rees Cyclop. 37 : no. 17, 1819; Cooke, 320; Gamble, 983; Pellegrin, 474.

Utricularia orbiculata Wall., Cat. 1500; Oliver, 187; Dalz. & Gibs., 136; Clarke, 334; Kamienski, 121; Göbel, 53–60, f. 28–36 and 68–70.

Utricularia glochidiata Wight, Icon. t. 1581.

Utricularia pusilla Graham, Cat. 165.

About the most noticeable of the Utricularias of Bombay. It grows both on wet rocks and on tree trunks; it is remarkable, however, that on either rocks or trees it generally occupies vertical surfaces, possibly because though requiring abundant water for its growth, it cannot stand water-logged conditions.

The more common colour of the flowers is purple with a yellow spot at the base of the lower lip; not seldom the colour is pure white with the yellow spot mentioned; between these two colours, there is a great range of shades; often the outer rim of the lower petal is purple or rosy pink, and between this rim and inner yellow spot there is a ring of pure white.

This plant is also noticeable on account of its being the first *Utricularia* to come into flower; in Khandala I have seen plants in flower about a week after the first rains of the monsoon.

When this plant grows on rocks, it is fairly easy to collect the whole plant including stolons with leaves and bladders; from tree trunks it is not so easy, as it is associated with mosses and liverworts which cannot be separated from *Utricularia* without more or less extensive damage to both plants. Leaves are orbicular, reniform or spathulate. Bladders very numerous. Seeds glochidiate all over, the glochidia being about as long as or a little longer than the diameter of the seed.

12. **Utricularia equiseticaulis** Blatter and McCann, in Journ. Ind. Bot. Soc. 10 : 122–123, pl. 1–2, 1931.

'Similar to *U. graminifolia* Vahl, but different by its branching stem, its many ovate-acuminate or ovate-acute scales of the scape, the broadly ovate or orbicular, acute superior and the bifid, ovate-oblong inferior lobe of the calyx, the fruiting pedicel not being recurved, the fruit compressed, seeds subglobose, marked with elongate fusiform areoles longitudinally arranged.' Blatt. and McC., loc. cit.

At first sight, this new species looks rather similar to, if not identical with, *U. squamosa* Wight; its description seems to fit Wight's specimens in Kew Herbarium; but having no authentic specimens of the new species, this point cannot be satisfactorily settled for the present.

13. **Utricularia ogmosperma** Blatter and McCann, loc. cit., 123–125, tt. 3–4, 1931.

'Similar to *U. albo-caerulea* Dalz., from which it differs by its broadly oblong-obovate bracts, the narrowly obovate upper lip of the corolla, the short and thick style, the fruiting pedicel not being recurved, the broadly ovoid, almost orbicular, much compressed fruit, the obliquely ellipsoid seed, the longitudinally and profoundly multi-sulcate testa.' (Blatt & McC., loc. cit.).

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A BIBLIOGRAPHY OF BIG GAME HUNTING AND SHOOTING IN INDIA AND THE EAST

BY

LT.-COL. R. W. BURTON, I.A. (RETD.)

When India achieved political freedom in August 1947 it occurred to the compiler of this bibliography that one eventual result would be the gradual fading from memory of the very existence of many books on hunting and shooting in India and the East.

It seemed therefore that it would be well to have a list of all such books published in the Society's *Journal* as a permanent record. It was also in mind that when going through the notebooks of the late Major H. G. H. Munrowd for the purpose of the serial (published in the *Journal*) 'Some Reminiscences of Sport in Assam', his bibliography of shikar books, would form a nucleus for the purpose. He possessed 45 titles and had read others.

The regret of the Society's Committee that the old sportsman did not live to see his experiences published in the *Journal* was expressed at close of Part V of the series. To that will now be added the gratitude of present and future members that it is owing to his initiative this more complete bibliography is made available to them. This further use of the notebooks is made with the consent of Mrs. Munrowd.

The thanks of the compiler are due to the Secretary of the Library of the British Museum; the Librarian of the India Office Library, Commonwealth Relations Office; the Librarian, Book Department, Messrs Rowland Ward Ltd.; the Mitchell Library, Glasgow, for research assistance helpfully afforded; and to Colonel R. C. Morris and Lieut.-Col. E. G. Phythian-Adams for their valuable aid.

It is hoped the lists are fairly complete. Members able to suggest additions or amendments are asked to send these to the Honorary Secretary.

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179. ,, ,,	Scottish Moors and Eastern Jungles.	1889
180. Niedieck, Paul	With Rifle in Five Continents.	1908
180a. Okeden, W. P.	Diary and Sporting Journal of India 1821-1841.	1906
181. Oriental Sporting Magazine	June 1828 to 1933, 2 vols. and 1868-79, 12 vols.	
182. Peacock, E. H.	A Game Book for Burma and Adjacent Territories.	1933
182a. Pester, Lieut. John	War and Sport in India, 1802-1806. Republished by J. A. Devenish.	1913
183. Pigot, Brig.-Gen. R.	Twenty Five Years' Big Game Hunting.	1928
184. Pollock, Lt.-Col. A. J. O.	Sporting Days in Southern India.	1894
185. Pollok, Col. F. W.	Sport in British Burma, Assam and Kossyah and Jaintea Hills: also Northern Hilly Districts of Madras Presidency. 2 Vols.	1879
186. Pollok, Col. F. T.	Incidents of Foreign Sport and Travel.	1894
187. ,, ,,	Fifty Years' Reminiscences of India.	1896
188. Pollok, Col. F. T. and Thom W. S.	Wild Sports of Burma and Assam.	1900
189. Prater, S. H.	Wild Animals of the Indian Empire and the Problem of their Preservation (*B.N.H.S. Journal*).	1936
190. ,, ,,	The Book of Indian Animals. (Much in these two books is of special use and interest to the Big Game sportsman.)	1948
191. Quincey, J. Wong	Chinese Hunter.	1939
192. 'Red Heather'	Memories of Sporting Days.	1923
193. Rice, William	Tiger Shooting in India—Rajpootana 1850 to 1854.	1857
194. Rice, Gen. William	Indian Game.	1884
195. Ronaldshay, The Earl of	Sport and Politics under an Eastern Sky.	1902
196. Roosevelt, Theodore	Trailing the Giant Panda.	1929
197. Rundall, L. B.	The Ibex of Sha Ping.	1915
198. Russell, C. E. M.	Bullet and Shot in Indian Forest, Plain and Hill.	1900

	Author	Title	Published
199.	Sanderson, G. P. ...	Thirteen Years Among the Wild Beasts of India. 1st edition. Other later editions up to 6th in 1907.	1878
200.	Savory, Isabel ...	A Sportswoman in India.	1900
201.	Selous, F. C. ...	Sport and Travel East and West. (Pp. 1 to 95 contain Asia Minor; The Maimum Dagh and the West Asiatic Red Deer (*Cervus maral*).	1900
202.	Sewell, E. H. D. ...	The Log of a Sportsman. (Much cricket, a little shooting).	1923
203.	Shakespear, Major H.	The Wild Sports of India.	1862
204.	Sheffield, Lt.-Col. Frank ...	How I Killed the Tiger. 2nd edition.	1902
205.	'Silver Hackle' ...	Man-eaters and Other Denizens of the Indian Jungles.	1928
206.	,, ,, ...	Indian Jungle Lore and the Rifle.	1929
207.	Simson, F. B. ...	Letters on Sport in Eastern Bengal.	1886
208.	Sinha, Raja Kirtyanand ...	Purnea—A Shikar Land.	1916
209.	Sirguja, R. Saran Singh, The Ramanaj of ...	Tiger Shooting.	
210.	Smith, Mervin A. ...	Sport and Adventure in the Indian Jungle.	1904
211.	Smythies, E. A.	Big Game Shooting in Nepal.	1942
212.	'Snaffle'. (Henry Dixon) ...	Gun, Rifle and Hound in East and West.	1894
213.	Somerville, Augustus	Shikar near Calcutta—with a Trip to the Sunderbans.	1924
214.	Sowerby, A. C. ...	Sport and Science on the Sino-Mongolian Frontier.	1918
215.	'Spy-Glass' ...	Tramps in the Indian Jungles.	1923
216.	Stebbing, E. P. ...	Jungle By-Ways in India.	1911
217.	,, ,, ...	Stalks in the Himalaya.	1912
218.	,, ,, ...	The Diary of a Sportsman and Naturalist in India.	1920
219.	Stephens, Martin ...	Fair Game—The Open Air of Four Continents.	1936
220.	Sterndale, R. A. ...	'Seonee', or Camp Life on the Satpura Range.	1887
221.	,, ,, ...	Denizens of the Jungles: A Series of Sketches in Pen and Pencil. (Oblong Quarto).	1881
222.	Stewart, Col. A. E. ...	Tiger and Other Game.	1927

Author	Title	Published
223. Stewart, R. M.	Round the World with Rod and Rifle.	1924
224. Stockley, Col. V. M.	Big Game Shooting in India, Burma and Somaliland.	1913
225. Stockley, Lt.-Col. C. H.	Big Game Shooting in the Indian Empire.	1928
226. ,, ,,	'Shikar', being Tales told by a Sportsman in India.	1928
227. ,, ,,	Stalking in the Himalayas and Northern India.	1936
227 a. Stone, S. J.,	In and Beyond the Himalayas. A record of Sport and Travel in the abode of snow.	1896
228. Storey, Harry	Hunting and Shooting in Ceylon. 2nd edition.	1907
229. ,, ,,	A Ceylon Sportsman's Diary.	1921
230. Strachan, Arthur W.	Mauled by a Tiger.	1933
231. Sutton, R. L.	Tiger Trails in Southern Asia.	1927
232. Swayne, H. G. C.	Through the Highlands of Siberia.	1904
232 a. Taylor, John ('Pondoro')	Big Game and Big Game Rifles	1948
233. Taylor, Major Neville	Ibex Shooting on the Himalayas.	1903
234. Tennent, Sir James Emerson	Ceylon. 2 vols.	1859
235. 'The Field'	The British Sporting Exhibition. A fully illustrated catalogue of the Game Animals of the World. pp. 72.	1938
236. The Sportsman's Library	Vol. 23. Big Game of India.	1937
237. Todd, W. H.	Tiger! Tiger!	1927
238. ,, ,,	Work, Sport and Play.	1928
238 a. Tulloch, Col. Maurice	The All-in-one Shikar Book (Illustrated).	1948
239. Tutein-Nolthenius, A. C.	37 Years of Game Protection in Ceylon.	1907
240. Tyacke, Col. R. H.	The Sportsman's Manual for Kulu, Lahoul, Ladak, Spiti to the Tso Morari Lake.	1893
	Another edition.	1929
241. Tyacke, Mrs. R. H.	How I Shot my Bears.	1893
242. Wallace, F.	Big Game.	1934
243. Wallace, H. F.	Stalks Abroad.	1908
244. Wallace, W. H.	Big Game of Central and Western China.	1913
245. Ward, Col. A. E.	The Tourist's and Sportsman's Guide to Kashmir and Ladak. 4th and revised edition.	1896

Author	Title	Published
+246. Ward, Rowland F.Z.S.	Horn Measurements of the Great Game of the World. 10th edition.	1935
247. ,, ,, ...	The Sportsman's Handbook to Practical Collecting and Preserving Trophies.	1900
248. Wardrop, Gen. Sir Alexander, and Morris, C.W.G. ...	Days and Nights with Indian Big Game.	1923
249. Webber, Thomas W.	The Forests of Upper India and their Inhabitants.	1902
250. Whistler, Hugh ...	In the High Himalayas.	1924
251. Whitney, Caspar ...	Jungle Trails and Jungle People.	1905
252. Williamson, Capt. Thomas ...	Oriental Field Sports. Oblong quarto. Coloured plates.	1807
253. Williamson, Capt. Thomas ...	Oriental Field Sports. Crown quarto. Uncoloured Plates.	1808
+254. Wilson, Col. Alban ...	Sport and Service in Assam and Elsewhere.	1924
255. Wood, Lt.-Col. H. S., I.M.S. ...	Shikar Memories.	1934
256. Woodyatt, Maj.-Gen. Nigel ...	My Sporting Memories.	1923
257. Wray, John Willoughby ...	With Rifle and Spear: reminiscences of Sport in India.	1925

Many sportsmen are interested in the natural history of the big game animals they seek, and some of the other animals they may meet with.

The following will supply the need:—

'A'

1. Phillips, W. W. A. ...	Manual of the Mammals of Ceylon.	1937
2. Pocock, R. I. ...	Fauna of British India, Mammalia.	
	Vol. I.	1939
	Vol. II.	1941
3. Prater, S. H. ...	Nos. 189 and 190 of the Bibliography.	

4. The Journals, existing and future, of the Bombay and Ceylon Natural History Societies.

In addition to these there are older, also more recent books which some may wish to consult:—

AUTHOR	TITLE	PUBLISHED
B		
1. Blanford, W. T. ...	MAMMALIA: FAUNA OF BRITISH INDIA SERIES.	1891
2. Jerdon, C. T. ...	MAMMALS OF INDIA.	1867
3. Kelaart, E. F. ...	PRODROMUS FAUNAE ZEYLANICAE. (Ceylon)	1852
4. Lydekker, R. ...	THE DEER OF ALL LANDS.	1898
5. ,, ,, ...	THE GREAT AND SMALL GAME OF EUROPE, WESTERN AND NORTHERN ASIA AND AMERICA.	1901
6. ,, ,, ...	THE GAME ANIMALS OF INDIA, BURMA, MALAYA AND TIBET. Second edition, edited by J. G. Dollman.	1924
7. Sterndale, R. E. ...	MAMMALIA OF INDIA.	1884
8. ,, ,, ...	MAMMALIA OF INDIA. New and abridged edition.	1929
9. Tennent, Sir James Emerson ...	NATURAL HISTORY OF CEYLON.	1867
C		
1. Eardley-Wilmot, Sir S.	THE LIFE OF A TIGER.	1911
2. ,, ,,	THE LIFE OF AN ELEPHANT.	1912
3. Hingston, R. W. G. ...	A NATURALIST IN HIMALAYA.	1920
4. ,, ,, ...	A NATURALIST IN HINDUSTAN.	1923
5. Hooker, Sir Joseph ...	HIMALAYAN JOURNALS: OR, NOTES OF A NATURALIST IN BENGAL AND SIKKIM.	1854
6. Kipling, Lockwood ...	BEAST AND MAN IN INDIA.	1892
7. ,, Rudyard ...	THE JUNGLE BOOK. Illustrations in colour.	1909
8. ,, ,, ...	THE SECOND JUNGLE BOOK.	1895
9. Mockler-Ferryman, A. F. ...	THE LIFE STORY OF A TIGER.	1910
10. Selous, F. C. ...	EAST AND WEST.	1900
11. Spittel, R. L. ...	WILD CEYLON.	1924

Pigsticking is not 'Big Game Hunting'. It is, however, a famous classic field sport—one of the principal sports of India—so the only two books wholly devoted to the subject are here included:—

Baden-Powell, The Rt. Hon. Lord ...	PIG STICKING, OR HOG-HUNTING.	1924
	Revised and enlarged edition.	1936
Wardrop, General Sir Alexander ...	MODERN PIGSTICKING.	1912
	Second edition.	1930

The following list of articles selected from the *Journal of the Bombay Natural History Society* is by way of appendix to the bibliography as affording information of interest to sportsmen which they will not be able to obtain without purchase of a number of the books in the bibliography, most of which are out of print, and many difficult to find.

ANIMAL	TITLE AND AUTHOR	PUBLISHED
1. BEARS.	The Black and Brown Bears of Europe and Asia. An illustrated scientific paper by R. I. Pocock, F.R.S., F.Z.S. Vol. 35, pp. 771 *et seq*, and Vol. 36, pp. 101 to 138. (See No. 45 below).	1932
2. BISON	The Indian Bison, with some Notes on Stalking him. By J. D. Inverarity, Vol. 4, pp. 294-310.	1890
3. —	On the Gaur (*Bos gaurus*) and its Allies. By W. T. Blanford, F.R.S., F.Z.S. Vol. 6, pp. 222-230.	1890
4. —	The Gaur and the Gayal (*Bos gaurus* and *Bos frontalis*). By E. C. Stuart Baker, F.Z.S. (With 16 text-figs) of horn types. Vol. 15, pp. 227-248.	1903
5. —	*To be read with the above:*— The Gayal or Mithun (*Bos frontalis*). By T. R. Livesey, F.Z.S. (With 2 excellent photographs) Vol. 35, pp. 199-202; and Note at page 444 of Vol. 35 by J. C. Higgins, I.C.S.	
6. —	Some Notes on Bison (*Bos gaurus*) in Burma. By W. S. Thom, I.P. (Retd.). (With four excellent photographs). Vol. 37, pp. 106-123.	1934
7. BUFFALO	The Indian Wild Buffalo. By J. D. Inverarity. (Excellent photographs of a bull, and of horn types from Central Provinces). Vol. 10, pp. 41-52.	1895
8. —	Shooting Wild Buffalo in the Kosi River Swamps. By J. E. Hall. (Good photo of bull.) Vol. 38, pp. 585-592.	1936
9. DEER	The Larger Deer of British India. By R. I. Pocock, F.R.S., F.Z.S. A scientific series. Introduction and general. (With 8 text-figures), Vol. 43, pp. 298-317.	1943

ANIMAL	TITLE AND AUTHOR	PUBLISHED
	Swamp Deer and Thamin. (With 7 text-figures). Vol. 43, pp. 553-572.	1943
	The Sambar. (With 3 text-figs). Vol. 44, pp. 27-37.	1943
	The Chital and Hog Deer. Vol. 44, pp. 169-178.	1943
10. DEER ...	Notes on the Hog Deer (*Cervus porcinus*) in Burma. By Veterinary Captain G. H. Evans, A.V.D. (With 2 plates of the animal and the horns.) Vol. 14, pp. 310-315.	1902
11. — ...	The Chital or Spotted Deer. By J. D. Inverarity. (With excellent plate of a stag and of horn types, C.P.). Vol. 9, pp. 481-485.	1895
12. — ...	Notes on Sambar and Sambar Shooting. By J. D. Inverarity. (With excellent plate of a stag.) Vol. 8, pp. 391-395. *Note.* For the Kashmir Stag, and many other animals see Serial No. 45 of this list.	1894
13. — ...	Notes on the Thamin, or Brow Antlered Deer. By Veterinary Captain G. H. Evans. A.V.D. (With plate showing horns). Vol. 9, pp. 326-333. (This should be read with Richardson, Vol. 7, No. 2. and Gilbert, Vol. 18, No. 4. 1893/94).	1895
14. — ...	The Shou (*Cervus wallichi*) Northern Bhutan, Sangpo, and Brahmapootra Valleys and Southern Tibet, is among the largest of the red deer. (See also Ward, Vol. 30, No. 4. pp. 719-720 in item 45 of this list).	
15. — ...	Thorold's Stag (*Cervus thoroldi*) from Tibet, and on the Mammals of the Tibetan Plateau. By W. T. Blanford, F.R.S., F.Z.S. (With an excellent plate of this rare stag). Vol. 8, No. 4. pp. 540-544.	1894

Animal	Title and author	Published
16. Goats	The Serows, Gorals and Takin of British India and the Straits Settlements. By R. I. Pocock, F.R.S., F.Z.S. Part I. (With good plate of male takin). Vol. 19, No. 4. pp. 807-824.	1910
	Part II. Coloured plates, and text-figs. Vol. 22, No. 2. pp. 296-319.	1913
17. —	Note on Takin (*Budorcas taxicolor*) from the Mishmi Country. By Captain F. M. Bailey. (With 10 photo illustrations of horns and skulls.) Vol. 21, No. 3. pp. 1059-1071.	1912
18. Sheep	Notes on a trip after the *Ovis poli*. By Colonel G. D. F. Sullivan, late 4th D.G.'s. (A good photograph of a ram, and a head with 63 inch horns.) Vol. 18, No. 1, pp. 67-77.	1907
19. —	Notes from an expedition for *Ovis poli*. By William J. Morden, American Museum of Natural History. (Illustrated.) Vol. 34, pp. 142-148.	1930
	Note. Other good articles on hunting this now much more rare sheep, record horns for which are 75 inches but none approaching that now obtainable, are in Vol. 10, (1895); Vol. 13, (1901); Vol. 23, (1915). A note on its distribution is at page 216 of Vol. 37.	
20. —	*Ovis ammon hodgsoni*. A good photo of this, the largest wild sheep in the world, is at page 980 of Vol. 19.	
21. —	*Ovis vignei*. Article—'Notes on Oorial'. By Lt.-Col. C. H. Stockley at pages 1126-7-8. of Vol. 28. is of use and interest to sportsmen. Records of horns of the species in various localities are in Rowland Ward's book listed in the Bibliography.	
22. Lion	The Lions of Asia. By R. I. Pocock, F.R.S., F.Z.S. (With 5 plates, 4 text-figures of skulls,	

ANIMAL	TITLE AND AUTHOR	PUBLISHED
	and a map.) Vol. 34, pp. 638-655.	1930
23. LION	The Kathiawar Lion. By Lt.-Col. L. L. Fenton. Vol. 19, No. 1, pp. 4-15. (Also see Vol. 48, pp. 493-514).	1909
24. TIGER	Tiger Shooting in Burma. By W. S. Thom, I.P. (Retd.). (With 2 plates.) Vol. 37, No. 3. pp. 577-603.	1934
25. —	A Central Provinces Tiger. By Captain C. R. S. Pitman, F.Z.S. Vol. 30, No. 2. pp. 459-462.	1925
26. —	Some Reminiscences of Sport in Assam. By H.G.H.M. in five parts. Vols. 45 and 46.	1946
27. —	Tigers. By R. I. Pocock, F.R.S., F.Z.S. (With one coloured plate and 12 black and white plates. An exhaustive and scientific article.) Vol. 33, No. 3, pp. 505-541. *Note.* For naturalists there are the books previously listed, of which Pocock's 'Mammalia' deals with all the carnivora of the Indian region.	1929
28. PANTHER	The Panthers and Ounces of Asia. By R. I. Pocock, F.R.S., F.Z.S. (With illustrations of skins and skulls). Vol. 34, No. 1. pp. 64-68. Vol. 34, No. 2. pp. 307-336.	1930
29. —	The Panther as I have known him. By Lt.-Col. A. E. Mosse, I.A., F.Z.S. Vol. 34. (3 plates) pp. 350-356. Vol. 34. (1 plate) pp. 673-679. Vol. 34. pp. 1015-1023.	
30. PHOTOGRAPHY	Stalking a Herd of Saing. By E. H. Peacock, F.Z.S. (With 4 photographs.) Vol. 37, pp. 278-288. (Reprinted from '*The Field*'.)	1934
31. —	Where Big Game Takes the Waters. By E. H. Peacock, F.Z.S. (With 3 plates.) Vol. 37, No. 4, pp. 780-783.	1935
32. —	The Malayan Gaur or Seladang (*Bibos gaurus hubbacki*). By Theodore Hubback, F.Z.S.	

Animal	Title and author	Published
	(With 5 excellent plates.) Vol. 40, pp. 7-19.	1938
33. Elephant	Wild Elephants in the United Provinces. By F. W. Champion, I.F.S., F.Z.S. With four plates. Vol. 32, No. 1, pp. 126-132.	1927
34. —	Wild Elephants in Assam. By J. E. Hall. (With a plate. Mostly about shooting.) Vol. 41, No. 3, pp. 563-572.	1940
35. —	The Malayan Elephant (*Elephas maximus indicus*). By Theodore Hubback, F.Z.S. (With 8 plates of outstanding merit.) Vol. 42, No. 3, pp. 483-509.	1942
36. —	An Elephant Shoot in the Baragur Hills, Madras Presidency. By Randolph C. Morris, F.Z.S. (With 2 photographs of tusks.) Vol. 31, No. 3, pp. 720-725.	1926
37. —	A Further Shoot in the Baragur Hills. By Randolph C. Morris, F.Z.S. (Photographs of the elephant and of the tusks 8 ft. 2 in, each 91 lbs.) Vol. 33, No. 4, pp. 861-868.	
38. Rhinoceros	A Note on the position of the Rhinoceros in Burma. By W. F. H. Ansell. (With map and plate, also a full list of references.) Vol. 47, No. 2, pp. 249-276.	1947
39. —	Rhinoceros Shooting in Burma. By W. S. Thom, I.P. (Retd.). (With 2 photographs.) Vol. 38, No. 1, pp. 137-150.	1935
40. Tapir	The Malay Tapir (*Tapirus indicus*). By W. S. Thom, I.P. (Retd). (With one plate.) Vol. 38, No. 3, pp. 479-483.	
41. Shikar Articles	Some experiences amongst Elephant and other Big Game of Burma from 1887 to 1931. By W. S. Thom, I.P. (Retd.). (With 2 photographs.) Vol. 36, No. 2, pp. 321-333.	1933
42. —	A Journey to Siam and back. By Lt.-Col C. H. Stockley,	

Animal	Title and author	Published
	F.Z.S. (Illustrated.) In four parts in Vol. 29 and the last part in No. 2. of Vol. 30.	1925
43. Shikar Articles ...	A Sporting Trip to the Pindari Glacier. By W. H. A. Shortt. (With three plates.) Vol. 30, parts 1 and 2.	1923
44. — ...	Three Months up the Sutlej Valley. By Lt.-Col R. W. Burton, I.A. (Retd). (Illustrated with photographs.) Vol. 31, pp. 23-39. Vol. 31, pp. 352-367.	1920

(Read with H. W. Waite's article on 'Birds of the Sutlej Valley' in Vols. 45 and 46; and Wynter-Blyth's Sutlej and Baspa Valley article on Butterflies in Vol. 47., these three accounts give about all the available information concerning the valley of the Sutlej River and the Hindustan-Tibet Road).

45. Kashmir ...	1. Big Game Shooting of Kashmir and the Adjacent Hill Provinces. 2. The Mammals and Birds of Kashmir and the Adjacent Hill Provinces, being natural history notes.	

(These two fully informative and illustrated series by the late Colonel A. E. Ward, I.A. (Retd.), are in Volumes 28 to 33 of the Society's *Journal*, and are very necessary to the big game sportsman-naturalist shooting in those regions. The series 2 was not fully completed by the author.)

It has been suggested that a list of books on Angling should find permanent record at this place.

1. Bhattachariya, P. N.	Hints to Amateurs in Tank Angling.	
2. Conway, Capt. C. W. W. S. ...	Sunlit Waters.	1942
3. Lacy, G. H. ...	The Angler's Handbook.	1905
4. Macdonald, A. St. J.	Circumventing the Mahseer and Other Sporting Fish in India and Burma.	1948
5. 'Skene Dhu'. ...	The Angler in India, or Mighty Mahseer.	1923
6. Thomas, H. S. ...	The Rod in India. Second edition. (This is considered the best of the several published).	1881
7. Thomas, H. S. ...	Tank Angling.	

No. 4 includes chapters on sea angling, and contains references to the valuable articles on both freshwater and sea angling to be found in back numbers of the Society's *Journal*.

A NEW VARIETY OF *CUCURBITA MAXIMA*

BY

C. Rajasekhara Mudaliar, M.A.

(*Agricultural College, Coimbatore.*)

(*With two plates*)

Cucurbita maxima, Duchesne var. *badagarensis,* Mudaliar, C. R. var. nov.

Accedit ad *Cucurbitam maximam* Duch. colore foliorum, magnitudine et structura sepalorum, forma corollae et natura pedunculi frutescentis, differt vero magnitudine, colore et forma fructuum; accedit etiam ad *C. moschatam* generali aspectu culmorum, foliorum et florum, differt vero distincte structura tubuli corollae, pedunculo frutescente cylindrico et striato, pallido et uniformi colore foliorum viridi.

Folia pallide viridia, orbicularia, 12 cm. long, 14 cm. lata. Flores feminei 5-6 cm. diam., pallide lutei; corolla tubularis, tubo uniformiter lato et dimetiente 3.5 cm. diam.; flores masculi minores, 4.5-5 cm. diam.; corollae tubus uniformiter latus, 2.5 cm. diam. Flores apparent intra 45 dies post seminationem; varietas haec valde praematura est. Pedunculus fructifer cylindricus, striatus, crassitudine uniformi (nec striatus nec expansus ad basim); fructus longi et cylindrici vel breves et globosi.

Annual, trailing herb 3 to 3.5 meters long, stem nearly cylindrical, slender, slightly prickly in the younger portions, almost glabrous when mature. *Leaves* light green both when young and mature, orbicular, 12 cms long, and 14 cms broad, indistinctly lobed, margin denticulate and slightly serrate near the base. *Flowers* medium sized, light yellow, monoecious (pedicel 2 to 3 cms in male flower and 5.5 to 7.5 cms in female flower). *Calyx* tube short, lobes linear 0.6 cms; *corolla* of pistillate flower, tubular, 3.25 cms across both at top and bottom (not expanding at top)—(plate 2). Staminate flower, comparatively small, 2 to 2.5 cms across. *Ovary* of pistillate flower long and linear or globular, lemon yellow in colour. *Fruit* long, or short and rounded, slightly ribbed, lemon yellow when tender, ripening to orange with stripes of light buff colour in the grooves (Plate 1); fruit stalk cylindrical, striated, uniform in thickness (not expanding near the base), (Plate 2, Fig. 5) flesh 2.5 cms thick at the middle, 3.75 cms at the extremities. *Seeds* flat, smooth, white glossy, margin dull white, mycropylar end oblique (Plate 2).

Madras Herbarium No. 93177 and 93178; (Malayalam—*Vellari mathan*) cultivated commonly in Malabar District; a quick growing plant flowering within 45 days after sowing; also a good yielder and duration up to 3½ months. The variety is named after the place, Badagara where it is largely grown.

In general appearance the new variety approaches *Cucurbita maxima* Duch. variety typical, in the colour of the leaf, size and shape

PLATE I

CUCURBITA MAXIMA Duch. var. BADAGARENSIS Mudaliar, C. R.

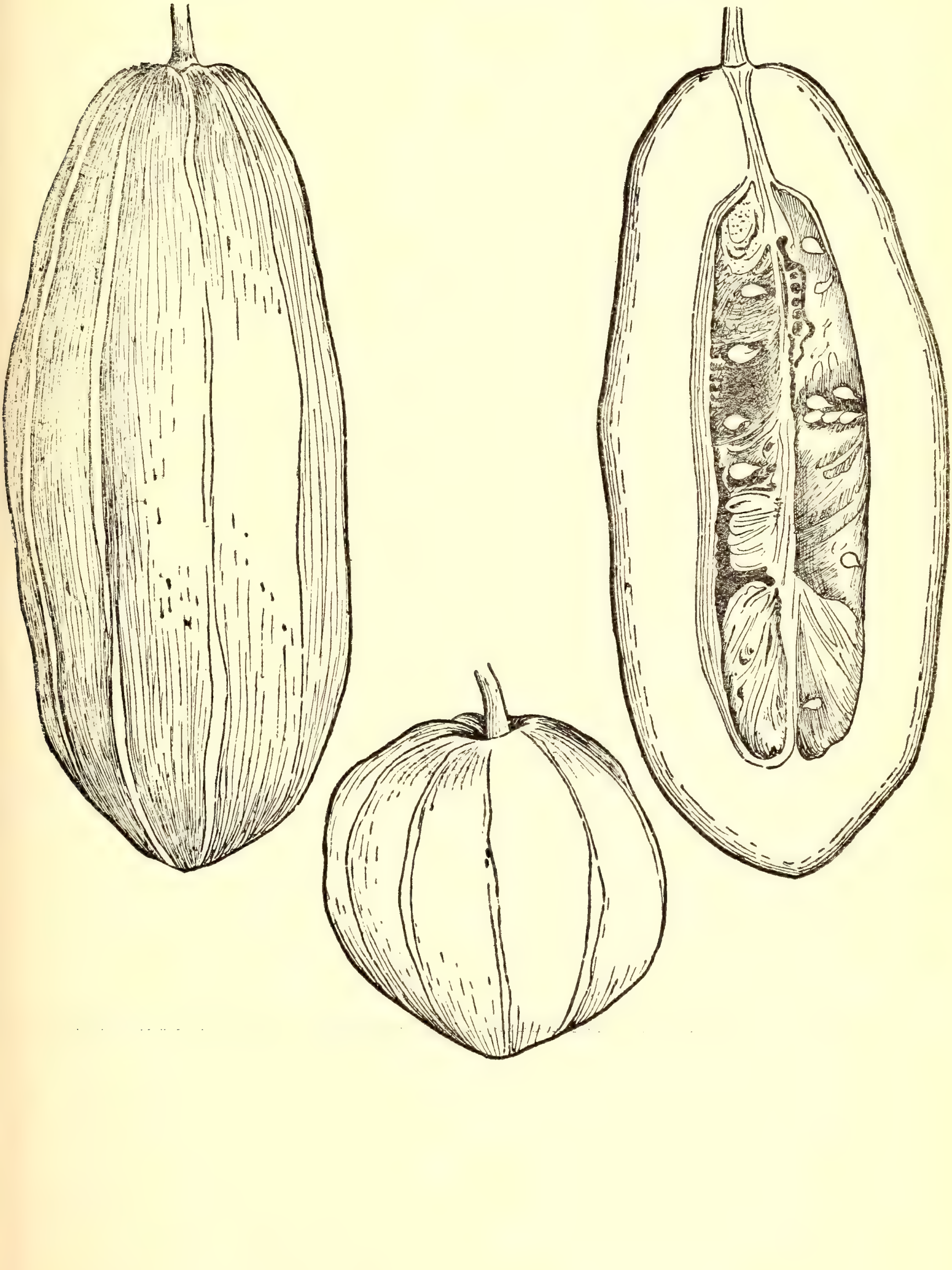
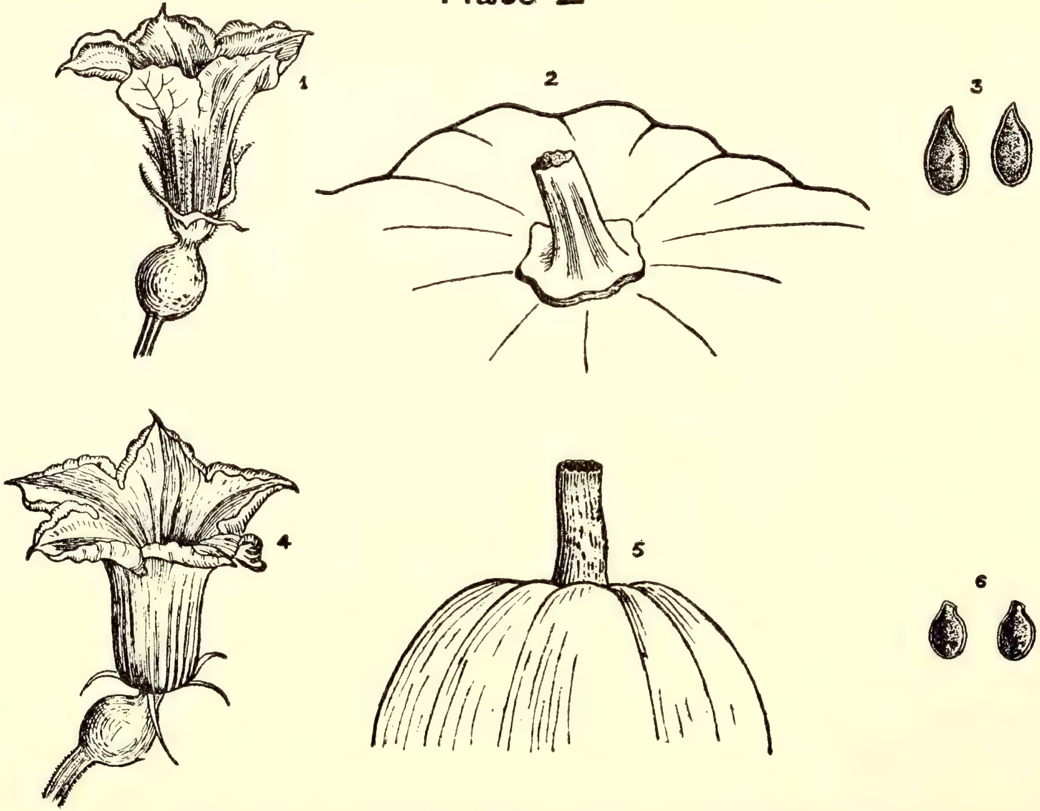


Plate 2



Figs. 1, 2, 3 Flower, fruit & seed of Cucurbita moschata
Figs. 4, 5, 6 " " " of " maxima

of sepals, corolla shape, and nature of fruiting stalk, as recorded by Oliver (1871), Clarke (1872), Woodrow (1898), Bailey (1902), and Hector; but differs in the following characters, namely, the size, colour, and shape of fruit, both when tender and when ripe, the time of flowering and the maturity of the fruit, etc. It resembles *Cucurbita moschata* only in the general appearance of the vine, the leaf and flowers, but differs distinctly in the following characters: (i) shape of the corolla tube which is of uniform width both at top and bottom; while in *Cucurbita moschata* the corolla tube is expanding gradually from bottom. (ii) Cylindrical and striated fruiting stalk as against the strongly grooved and widely expanding stalk of *Cucurbita moschata.* (iii) light green colour of the leaves as opposed to the dark green leaves with white blotches of *Cucurbita moschata.* Tapley (1937) who describes the different varieties of *Cucurbita maxima* of New York, has not recorded this variety. A large number of Cucurbita types were collected from different parts of the Madras Presidency and studied. Classification of South Indian pumpkins will form part of another paper.

The local name, *Vellari mathan*, suggested whether it may be a cross between *Cucumis sativus* Linn. (*Vellari*) and *Cucurbita moschata* Duch. (*Mathan*). A large number of artificial crosses were tried between these two species of different genera at the Agricultural Research Station at Pattambi with no success. Intergeneric crosses at Coimbatore between this new variety of *C. maxima* and *Cucumis sativus* also failed. Inter-specific crosses with *Cucurbita moschata* were mostly unsuccessful; the few set fruits did not have viable seeds at all. These are further evidences that this plant is of a distinct species, *Cucurbita maxima* Duch. There are two forms in this variety, one with longer fruits, 30 to 33 cms by 11 to 14 cms and another with short and rounded fruits, 10 to 14 cms. (Plate 1). These two forms cross easily with each other.

ACKNOWLEDGMENT

The author wishes to express his thanks to the Superintendent, Agricultural Research Station, Pattambi for permitting him to examine and study the crop in the Research Station at Pattambi and to Rev. H. Santapau for helping in Latin translation.

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NOTES ON BIRDS OF THE IRRIGATED AREA OF MINBU DISTRICT, BURMA

BY

W. L. Roseveare I.S.E. (Retd.)

(*With two sketch maps*)

INTRODUCTION

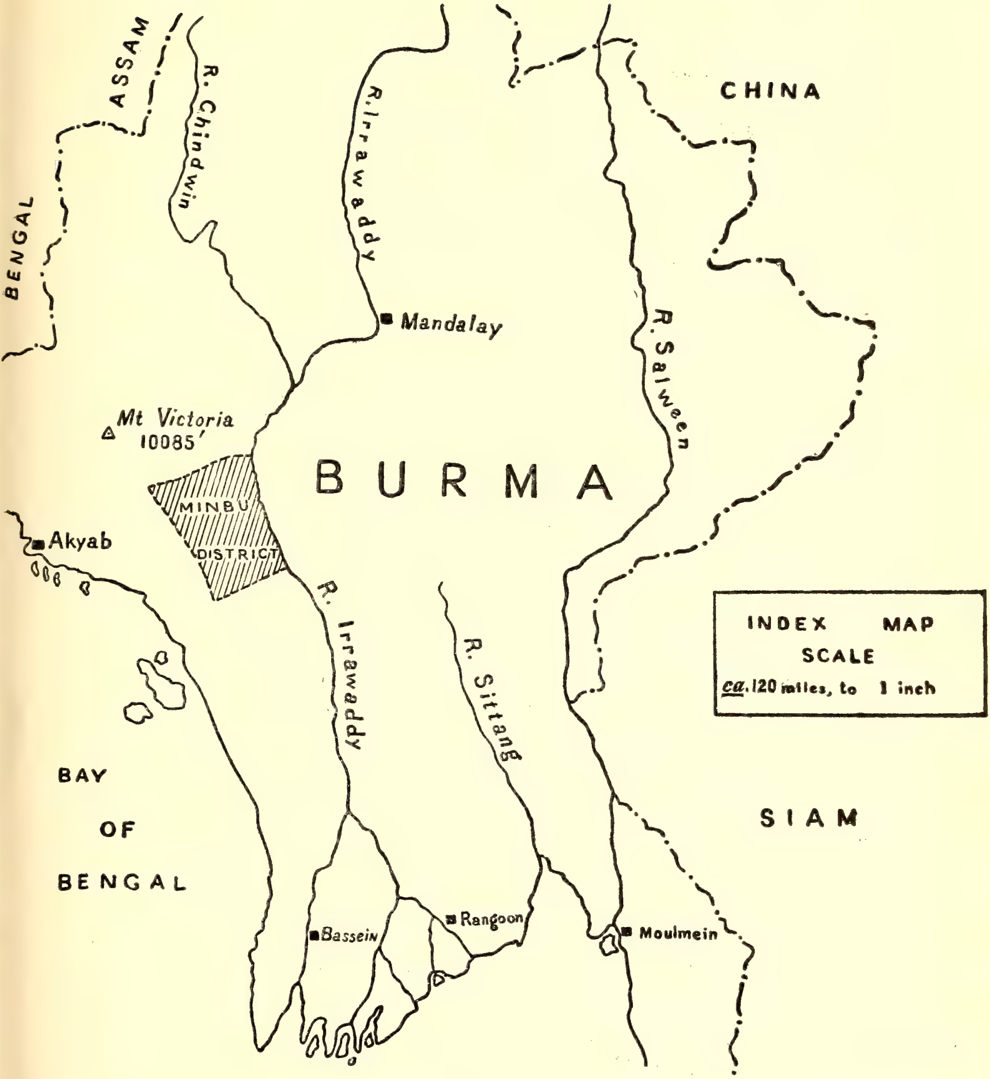
The following notes cover observations made during the period from October 1934 to February 1937. Except where otherwise stated, they were made in that part of the Minbu district which is irrigated by the government canals, in its immediate vicinity, or in the neighbourhood of Minbu town. The area is indicated on the accompanying rough sketch-map.

The notes are compiled entirely from visual observations, no attempt having been made to secure specimens. For the most part, especially under the headings 'Identification' and 'Habits', facts already recorded in Smythies' 'Birds of Burma' have not been repeated. The notes are, therefore, mainly supplementary to that excellent volume, and have been arranged under the same headings.

Particular attention was given to the status of each species throughout the year. The information given under that head has been compiled from a note-book in which each species was recorded at the end of each month as having been either very common, common, fairly common, uncommon or absent during the month in question. In the case of migrants, earliest and latest dates were also recorded.

Glossary of Burmese words

Chaung	A stream-bed that goes dry, or practically so, for part of the year.
Hti	(lit.) An umbrella. The word is applied to the metal ornament on the summit of a pagoda.
In	A shallow natural lake.
Indaing	Dry dipterocarp forest, without bamboos.
Kaing	Land in a river bed, exposed, and often cultivated in the dry weather.
Kazin	The low bank surrounding a rice field.
Kokkobin, Burmese	*Albizzia lebbek.* A forest tree.
Kokkobin, thimbaw	*Enterolobium saman.* A large common roadside tree.
Letpanbin	*Bombax malabaricum.* (The cotton tree). It grows to a very large size.


ASSAM
BENGAL
R. Chindwin
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CHINA
Mandalay
R. Salween
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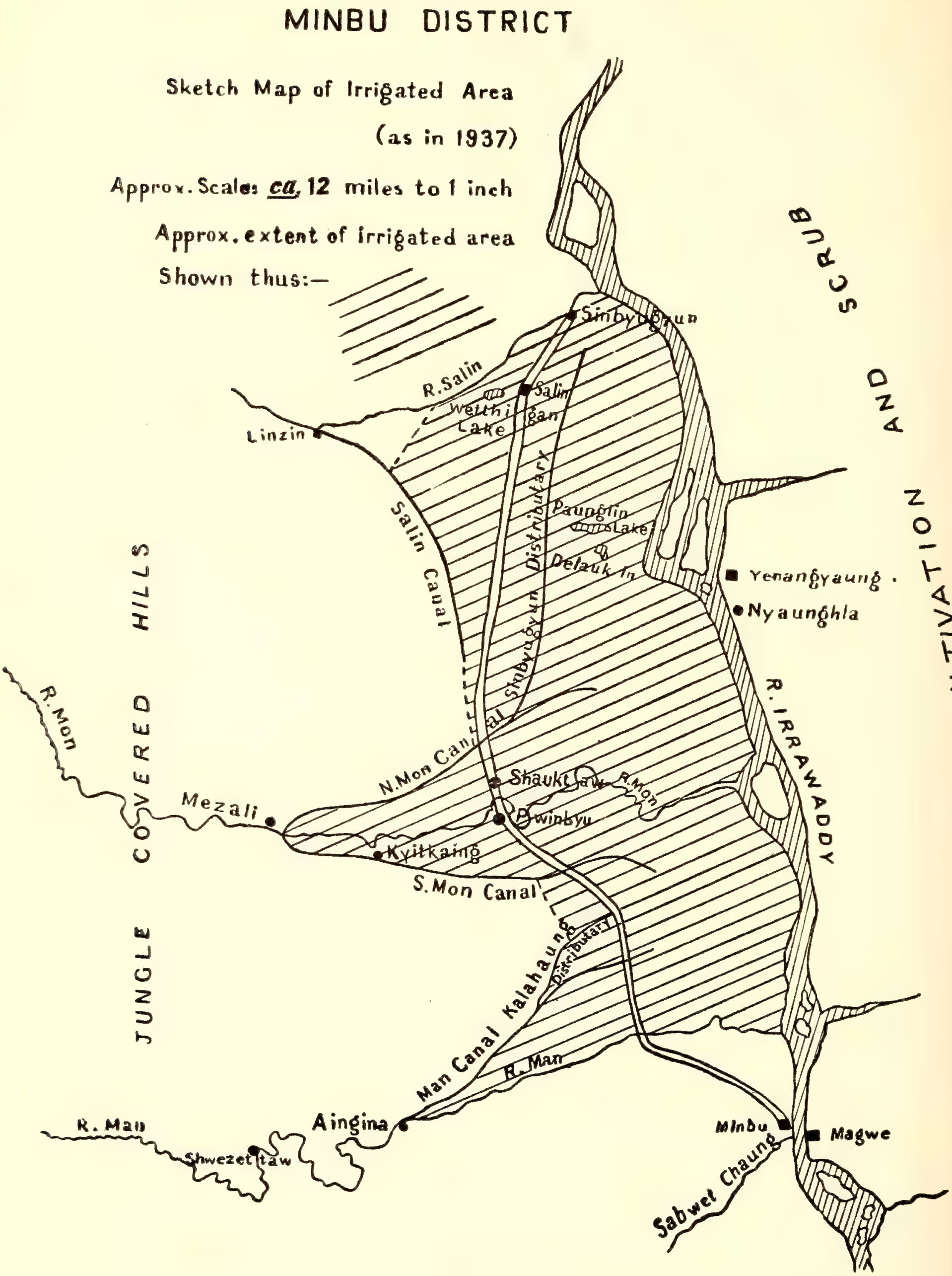
BURMA
MINBU
DISTRICT
Akyab
R. Irrawaddy
R. Sittang
INDEX MAP
SCALE
ca. 120 miles, to 1 inch
BAY
OF
BENGAL
SIAM
Rangoon
Bassein
Moulmein


MINBU DISTRICT
Sketch Map of Irrigated Area
(as in 1937)
Approx. Scale: ca. 12 miles to 1 inch
Approx. extent of irrigated area
Shown thus:—
Sinbyugyun
R. Salin
Salin
Welthi Lake
Igan
Linzin
Salin Canal
Sinbyugyun Distributary
Paungllin Lake
Delauk In
Yenangyaung
Nyaunghla
R. IRRAWADDY
SCRUB AND DRY CULTIVATION
JUNGLE COVERED HILLS
R. Mon
N. Mon Canal
Shauktaw
R. Mon
Mezali
Pwinbyu
Kyitkaing
S. Mon Canal
Kalahaung Distributary
Man Canal
R. Man
Aingina
R. Man
Shwezettaw
Minbu
Magwe
Sabwet Chaung

Mayin	A rice crop grown during the dry weather, and therefore practically restricted to the borders of *ins*.
Nyaungbin	*Ficus* sp. (The pipal tree).
Pyaung	Indian corn (maize).
Tanaungbin	*Acacia leucophloea*. A roadside tree of moderate size.
Taze	A large area, adjacent to the Irrawaddy, in the Minbu district, which is submerged only by very high floods.
Ya	Dry (i.e. unirrigated) cultivation, other than *kaing*.

ABBREVIATIONS

I.B.	Inspection bungalow.
B. of B.	'Birds of Burma' by Smythies.
F.B.I.	Fauna of British India (Birds).

LIST OF SPECIES

Corvus macrorhynchos. The Jungle Crow.

Habits.—Frequents paddy fields, *ya* land, river beds, *indaing* jungle and lakes. A flock of 20 or more was seen one November on the mud in the Mon river bed.

Status.—Common, or fairly so, throughout the year.

Corvus splendens. The House Crow.

Habits.—One June, in my compound in Minbu, I saw a bird catch a bat in flight. It carried it to a tree and dropped it.

Nesting.—Six or seven nests were observed in a single tree in Minbu on 3 April 1935. Two of these had only one egg each and some were empty.

Status.—Very common in every month.

Urocissa erythrorhyncha. The Red-billed Blue Magpie.

Status.—Seen once only, on 19 February 1935, when two birds were in *indaing* jungle near Mezali headworks.

Dendrocitta vagabunda. The Tree Pie.

Voice.—Once in August I saw and heard two birds calling with a subdued monosyllabic croak.

Habits.—Seen in compounds, *indaing* jungle, scrub jungle and *ya* land. Once in December I saw a bird on a telephone wire.

Status.—Not seen in June or July. Observed in most other months, but never common.

Crypsirhina cucullata. The Hooded Racquet-tailed Magpie.

Voice.—On 14 September 1935 I saw a bird perched on top of a tree and mewing rather like a Ring Dove.

Habits.—Sometimes seen in scrub and *indaing* jungle and in compounds, but usually on *ya* land.

Status.—Common in March and fairly so in April, but not seen between 30 April and 10 June, and uncommon in other months.

? Dryonastes caerulatus. The Kachin Hills Laughing Thrush.

Status.—On 14 October 1935 a bird spent several hours in the sitting room of my bungalow in Minbu. I did not see it myself, but from a description and sketch by my wife I have no doubt that it was a wandering member of this species. It was about the size and shape of a White-throated Babbler (*Argya gularis*), with the long tail chestnut above and light coffee colour below. There was some black on the nape or upper back, the flanks were grey and the lower plumage white.

Argya earlii. The Striated Babbler.

Voice.—A party of 6 or more, seen on *kaing* land in May 1936, were very noisy, uttering both a single whistling note rapidly repeated and a loud trisyllabic whistle ('kĕep quīĕt') also repeated. Another bird, seen in September 1935, was also uttering a loud whistle.

Habits.—Seen on *kaing* land, open grass land and marshes. Usually in bushes, but once feeding on the ground in long grass, with one bird of the party clinging to the side of a post. One party I watched in May was shy at first, but soon became inquisitive. Usually in small parties.

Status.—Only 6 observations, in March, May, September, November and December.

Argya gularis. The White-throated Babbler.

Habits.—Only seen in scrub and *indaing* jungle, and on *ya* land, not in compounds.

Nesting.—Fledglings, just able to fly, seen with parents on 3 May and 8 June.

Status.—Very common in all months.

Timalia pileata. The Red-capped Babbler.

Voice.—In the cold weather I have seen birds uttering both a soft crooning noise and a loud whistling call, with the same note rapidly repeated. Once in October I saw one uttering a beautiful little trilling call. I have no record of any song during the breeding season.

Habits.—Seen in *kaing* grass in the Man river bed, in bushes on the bank of the Irrawaddy, and once in a bush growing in Paunglin lake, but most often in scrub jungle and in thorn hedges of *ya* land. I saw a party one July feeding in long grass on the bank of a *chaung*, and bathing in a pool. From March to the middle of July it was always seen singly or in pairs, at other times in small parties of up to 6 or 8 birds. Once in May I saw a pair join three Yellow-eyed Babblers, which were feeding in bushes.

Food.—Once, in October, I saw a bird eating a chrysalis.

Nesting.—On 24 June 1936 I saw a nest in a thorn hedge, made of old coarse straw with a slightly finer lining. It was cup-shaped and had somehow been tripped up on one side. Two nestlings were being fed by the parents, who made no attempt to conceal the position. A nest found on 6 September 1935, in a very exposed position one foot up in a bush, was made entirely of coarse strips of bamboo leaves or similar material, and looked like a lump of rubbish. It contained three young birds. A pair of birds seen as late as 30 October 1935 evidently had young close by, as they swore hard at me and tried to drive me away.

Status.—Very local, but seen in every month except December. Fairly common from April to October, uncommon in other months.

Chrysomma sinensis. The Indian Yellow-eyed Babbler.

Voice.—A bird seen in January was uttering a trilling song and two phrases which I rendered 'Whȳ-ăre-yōu-hēre, keepoff' and 'Keep off' cānt yōu'.

Habits.—Usually in *ya* land and scrub. Three birds seen once in May in company with a pair of Red-capped Babblers.

Nesting.—No nests seen, but young birds observed with their parents as late as 2 October.

Status.—Fairly common from April to June, uncommon in other months.

Pellorneum ruficeps. The Spotted Babbler.

Habits.—Seen in *indaing,* in jungle at the edge of cultivation, and in bushes on river banks. One of the last-named birds flew down to mud in the river bed and then into long grass. Three out of four observations were of single birds, the fourth one was of a pair. One of the solitary birds was perching near the ground and jerking its head in perky fashion. Later it was feeding on the ground and under dead leaves. While watching it from hiding at ten yards distance, I sneezed violently, but it took no notice—a striking instance of birds' insensitiveness to noise.

Status.—Only seen four times in the area, in March, April, June and August. Probably all were *P. ruficeps minor,* though in only one case were the streaks on the upper plumage noticed.

Aegithina tiphia. The Common Iora.

Identification.—A male in full breeding plumage was seen as late as 7 August.

Voice.—On 13 September 1935, I saw a male calling with a loud three-syllable whistle, which on first hearing I took for an oriole's.

Habits.—Seen in scrub and *indaing,* villages and bungalow compounds. I once saw one swallowing a caterpillar.

Status.—Common, or fairly so, throughout the year.

Chloropsis aurifrons. The Gold-fronted Chloropsis.

Status.—Only seen once, on 18 December 1934, at Linzin headworks, when a single bird was feeding in a tree.

Molpastes cafer. The Burmese Red-vented Bulbul.

Habits.—Frequented *ya* land, scrub and *indaing.* A bird was once seen clinging to the trunk of a toddy-palm, like a nuthatch.

Nesting.—Nest with 3 eggs found on 17 July. This and another one seen in June, were both 6 to 8 feet up in bushes. The spots on the eggs were pale mauve, dark brown and black, and concentrated mostly in a wide ring round the larger end.

Status.—Very common throughout the year.

Pycnonotus jocosus. The Red-whiskered Bulbul.

Voice.—A shrill piping call heard in December.

Habits.—Seen in bushes and trees in bungalow compounds, in bushes in and on the edge of *ins,* and once in a hedge near a village. Seen in pairs, and in docks of upto a dozen birds.

Nesting.—On 15 March 1936, I saw a nest under construction 4 feet up in a bush at the edge of an *in.* It was being made mainly of coarse grass and leaves, with a little cotton from a cotton-tree.

Status.—Observed in all months except May and September, but always uncommon. Was identified as the Burmese race by its conspicuous red whiskers, on 1 February 1935 and 15 July 1935.

Pycnonotus flaviventris. The Black-crested Yellow Bulbul.

Status.—Only seen twice in the area, firstly a pair in jungle near Mezali headworks on 24 November 1935, and two days later another pair in a tree on the Man canal bank near Aingma headworks.

Iole virescens. The Olive Bulbul.

Status.—Only seen once, on 26 November 1935, when 2 or 3 birds were observed feeding on top of a tall tree near the inspection bungalow at Aingma headworks. Identified by absence of crest, yellowish green of crown and whole upper plumage, brown flight and tail feathers, pale yellow of whole lower plumage. Judging from their size, which appeared slightly larger than a Red-vented Bulbul perched close by, they were probably the Siamese race, which according to F.B.I. is larger than the others. According to Hand list in B. of B., not previously recorded from this area (Plains, S. Burma).

Pycnonotus blanfordi. Blandford's Olive Bulbul.

Habits.—Found in *ya* land, scrub and *indaing*, and in compounds.

Nesting.—Several nests seen, all between 4 feet and 10 feet from the ground. One was at the end of a low branch of a mango tree, the others in bushes. The nests were very loosely woven, the material used in one being grass bents and cobwebs. Those found on 15 May 1936 and 18 August 1936 each contained two young, one found on 27 June 1936 contained 3 eggs.

Status.—Very common throughout the year.

Saxicola caprata. The Burmese Stonechat.

Habits.—Seen on *ya* and *kaing* land, in scrub, compounds, and on vegetation in lakes. On 9 January 1937, in scrub jungle, I saw a male behaving in an unusual manner. It kept on returning to one spot and uttering a shrill alarm cry, but I could not discover the reason.

Nesting.—The only nest seen was on 14 April 1935 in a hole in a bank, a few inches deep, lined with grass. Both birds were feeding young.

Status.—Common in March, uncommon in April, fairly common in May, and very common in other months.

Saxicola torquata. The Bush-chat.

Identification.—At least one of many males seen on 27 October 1935 had the usual black face, but the crown and nape dark grey. In the White-tailed race (*S.t. leucura*) the absence of the rufous from the abdomen is noticeable in the field.

Habits.—Seen in lakes, river beds, *kaing* and *ya* land, and in paddy fields. Once in September, I saw a number of birds feeding in water-hyacinth which had been left high and dry by a receding flood. In January I watched a number of birds, perched on grass stems, which were moving their tails slowly up and down, and at the same time fanning them rapidly, exposing the white on the lateral tail-feathers.

Nesting.—On 1 March 1936, a pair of the White-tailed race were feeding green caterpillars to their young just hatched. The nest was at the end of a tunnel at least a foot long in a heap of straw on an island in the Irrawaddy, and was unlined. The male was very wary in approaching the nest, but, when the female appeared and went almost straight to it, he plucked up courage and followed suit. Birds were very numerous in the vicinity and at least one other female was seen with food.

On 5 June 1936 a pair of birds, presumably of the White-tailed race, were seen with 3 or 4 fledglings on an island in the river.

Status.—Very uncommon from May to August, uncommon in September, very common October, November and December, common in January and February, fairly so in March, but not seen in April.

Rhodophila melanoleuca. Jerdon's Bush-chat.

Status.—Only identified once, on the Paunglin lake on the 4 August 1935, when a female was seen both in flight and perching on the rushes, flirting her tail. The greater length of the latter, compared with that of the female Stonechat was noticeable.

Rhodophila ferrea. The Dark Grey Bush-chat.

Status.—Only two good observations. The first was on 5 December 1935, when a male was seen in the river bed at Minbu hawking flies from a perch on a snag. The other was on 12 June 1936, when a female was seen in open scrub near Minbu, flying about and perching conspicuously. The more slender build and longer tail, compared with the Stonechat, were noticeable, and, in the case of the female, the white wing patch and the chestnut in the tail were conspicuous.

On 4 August 1935, several dark grey chats with white wing patches were seen perched on rushes in the Paunglin lake. In spite of the unlikely locality and terrain the plumage seems to identify this species.

Luscinia svecica. The Red-spotted Bluethroat.

Status.—Only seen twice in the area, firstly on 27 June 1935, when a bird was clinging to *kaing*, grass in the *tazé* area, and secondly on 19 April 1936, when I had a very good view of a bird in the *mayin* paddy fields of the Paunglin lake. It was very tame and was running about feeding in the open on a dry *kazin*. The white supercilium was conspicuous, and the blue of the throat appeared paler than usual.

Calliope calliope. The Common Rubythroat.

Status.—Only seen twice, both occasions being on 12 January 1936, alongside a stream near Kyauk-O. The first bird was flying among bushes, calling 'chuck-chuck' throatily. Soon after, a male perched conspicuously within 5 yards of me, calling and answered by another out of sight.

Copsychus saularis. The Indian Magpie-Robin.

Habits.—Seen mainly in compounds and on *ya* land, but also in riverbeds, lakes and *indaing* jungle.

Status.—Uncommon in September, common in all other months, especially from January to March.

Kittacincla malabarica. The Shama.

Status.—Only seen twice, on 12 January 1936 alongside a stream in scrub jungle near Minbu, and on 23 April 1936 in a jungle-filled ravine near Mezali headworks. The first bird settled on a bush. The second one was perched on a tree, singing beautifully.

Monticola solitaria. The Blue Rock-Thrush.

Voice.—I have heard the whistle uttered in flight, and once in March I saw a bird uttering a harsh call something like a Roller's.

Habits.—One bird I watched in March was bowing so vigorously that its head nearly came down to the level of its feet. Seen in compounds, *indaing* and scrub. Usually solitary, but I once saw a party of three in flight.

Status.—Uncommon in this area. Earliest date October 9, latest April 7.

Siphia parva. The Red-breasted Flycatcher.

Habits.—Seen mainly in compounds, but also in *ya* land, scrub, and along canals.

Status.—Common, or fairly so, from October to February, uncommon in March. Earliest October 18, latest March 19. In 1936 the first bird was not seen until December 15. November had been unusually hot, and possibly the southward movement had been delayed on that account.

Eumiyas thalassina. The Verditer Flycatcher.

Status.—Only seen three times in the area, all between December 1 and February 26, in I.B. compounds and scrub. All the birds were solitary, and one of them, instead of the usual hawking, was feeding by flitting about a mango tree.

Tchitrea paradisi. The Paradise Flycatcher.

Identification.—One bird I saw in April had chestnut back and wings, sharply contrasting with pure white tail, which was as long as the body only. This was presumably a male in its third year or more, but the plumage appears unusual. Another seen in August had the body all white, but only a short tail.

Habits.—Usually seen in flight along canals, within a few miles of their heads, but also in scrub and *indaing,* and once flycatching among mangoes in an I.B. compound. The last named bird, a female or young male, was in company with White-browed Fantail Flycatchers. Usually seen solitary or in pairs, but once, on 15 April 1935, in a party which included two males in full adult plumage. One adult male I saw in August was perched in a tree eating a large beetle or similar insect. Sometimes it held it in its beak, sometimes under one foot.

Status.—Seen quite often between 15 April and 13 September, both in 1935 and 1936, but never outside those dates. On 6 May 1935 I recorded it as quite common at that time, while in April 1936 I saw 4 separate adult males on the 23, and 2 more on the 24, all of them along the canals near Mezali headworks—a most unusual influx.

Hypothymis azurea. The Indian Black-naped Flycatcher.

Status.—Only one good and one probable record in the area. On 1 December 1935 a solitary female was seen on a branch in scrub near Minbu, eating a large butterfly. On 17 March 1935, a flycatcher, which was most probably a female of this species, flew into my house at Minbu. Near Yenangyaung, not far outside the area, I saw several females on 10 November 1935. They were in a tamarind tree alongside a stream, in scrub jungle.

Rhipidura aureola. The White-browed Fantail Flycatcher.

Habits.—Seen mostly along canal banks and on *ya* land, but also in scrub and *indaing,* villages and bungalow compounds. I have seen a party of 3 or 4 birds feeding among mango trees in my compound in Minbu. I once saw a bird feeding in the bed of a stream near Minbu.

Status.—Rather local in occurrence. I found it common, or fairly so, from January to May, absent in June and July, and uncommon from August to December.

Rhipidura albicollis. The White-throated Fantail Flycatcher.

Habits.—Only seen in *indaing* jungle. Its boldness was well shown on one occasion, when it perched within two yards of me, though I was unconcealed.

Status.—Never common, but observed in January, February, April, June, and August.

Lanius colluroides. The Burmese Shrike.

Identification.—One bird seen on 23 August had unusually large and conspicuous white wing patches.

Voice.—On 7 September 1936 I saw a bird in a tree uttering an unusual whining call.

Habits.—Found in bungalow compounds, paddy fields, *ya* and *kaing* land, and in scrub and *indaing*.

Status.—No nests seen, but, as in Shwebo, young birds, with their crowns still brown, were seen from June to August, the earliest being 27 June. Not seen between 18 March and 8 June, fairly common during the rest of June, common or very common in all months from July to March.

Lanius cristatus. The Brown Shrike.

Identification.—I saw a young bird with conspicuous black bars on the breast on 29 September 1935.

Habits.—Seen usually in bungalow compounds and on *ya* land, but also in paddy fields, lakes, river beds, scrub and along canal banks.

Status.—Earliest 15 September, latest 27 April. Uncommon in September, common or fairly so from October to February, uncommon in March and April.

Tephrodornis gularis. The Nepal Wood-Shrike.

Status.—Only seen once, on 31 August 1935 among scattered bushes on an open hillside near Minbu. A solitary bird was hawking flying insects from perches on the bushes, and occasionally descending to the ground. Although this method of feeding appears to be unusual, I have no doubt of the species. It appeared rather larger than the Burmese Shrike, but had a short square tail. Plumage, bill and legs were as in F.B.I.

Tephrodornis pondicerianus. The Common Wood-Shrike.

Voice.—A bird I watched in November was uttering a chattering whistle.

Habits.—Seen mostly in *indaing* jungle, but occasionally on *ya* land. I once saw a bird drink several times on the wing.

Status.—Observed in all months except July and August, but never common, and not seen between 21 June and 3 September.

Pericrocotus peregrinus. The Small Minivet.

Status.—Three observations only. On 17 February 1935 two birds were seen in *indaing* jungle near the Man canal head at Aingma, one of them eating a butterfly. On 28 April 1936 a solitary male settled in a tree on the Man river bank near Aingma. On 17 June 1936, in *indaing* jungle at the Mon canal head, a party of 5 or 6 was seen hawking insects actively, first in a high tree, and afterwards in low trees.

Pericrocotus erythropygius. Jerdon's Minivet.

Habits.—Seen only in scrub jungle. Usually solitary or in pairs, but family parties of 5 or 6 observed in December and January.

Nesting.—Nest found on 8 July 1936, twelve inches up in a low bush. Grass cemented with cobwebs formed a perfect 2″ circle on horizontal fork. Ornamented outside with bark, as I have found usual. Lined with a few pieces of grass, but the 3 eggs rested directly on the branch. No protection whatever from rain. The female looked ridiculous on the tiny nest. She was very bold, perching within a few yards of me. The eggs were still being incubated 8 days later, and the mother sat very tight.

Status.—Not seen in November or December, and uncommon during the rest of the year.

Lalage melaschista. The Grey Cuckoo-Shrike.

Status.—Seen once only, on 24 November 1935, in jungle near the Mon canals head, when a solitary female or young male was perched on a bush and hawking insects.

Graucalus javensis. The Large Cuckoo-Shrike.

Status.—Only seen four times in the area, all between 11 January and 28 April. All observations were of solitary birds, and two of them were in bungalow compounds. In one case, in January, the bird was chased out of a tree by a Red-vented Bulbul.

Artamus fuscus. The Ashy Swallow Shrike.

Habits.—Found in villages and river beds, round lakes, in *ya* land, scrub and *indaing*. Usually in flocks of ten to twelve, but sometimes as many as twenty. I once saw a bird drinking on the wing. In Minbu town they were fond of pagoda *htis* where they seemed to find many insects. In February 1937, flocks were frequently seen flying over Minbu from south to north at dusk.

Nesting.—On 2 April 1936 birds were seen flying about high up with what looked like nesting material. On 8 May 1936 a pair were nest building with grass bents in the *hti* of a pagoda at Minbu, and had been at it for a week or more. Crows were chased off with great vigour. On 26 May 1936 one of the birds was sitting, the other spending much time in courageously pursuing crows.

Status.—Uncommon in June and July, common or fairly so in all other months. Certainly not only a summer visitor.

Dicrurus macrocercus. The Black Drongo

Habits.—Ubiquitous. Usually solitary or in pairs, but between January and March 1935 I several times saw parties of about six flying up the Irrawaddy at dusk. On another occasion also at dusk, I saw 6 or 8 birds perched within a foot or so of the ground. I once saw a bird swoop down to the water surface, either for food or drink, return to its perch and shake the water off its feathers. In another area I once saw simultaneously one bird attacking a Pariah Kite, and another one a Pied Kingfisher.

Nesting.—Not observed in the area, but fledglings seen on 21 June 1936 and a young bird on 9 September 1935.

Status.—Very common in every month

Dicrur leucophaeus. The Pale Ashy Drongo.

Status.—On 1 October 1935 I watched a bird hawking insects from tamarind trees in my compound at Minbu. I only saw the bird in October, November, and February, and it was usually in *indaing* jungle. In November 1934 I found numbers of them at the Man canal head, but usually it was very uncommon.

Chibia hottentotta. The Hair-crested Drongo.

Status.—Only seen once in the area, on 27 October 1935, when a single bird was in a tamarind tree in my compound at Minbu. The turned-up ends of the tail were unmistakable, and a greenish gloss on the plumage was also noticed. It several times uttered a loud melodious whistle.

Dissemurus paradiseus. The Large Racquet-tailed Drongo.

Status.—Seen three times. On 17 February 1935 a bird was twice seen calling in *indaing* jungle near the Man canal head. On 29 April 1936 a bird was nest-building in a horizontal fork at the end of a *letpanbin* branch overhanging the Man canal near its head. The nest was 30 feet up and made of roots and wool. On 15 December 1936 a bird was seen in the I.B. compound at Salin.

? Acrocephalus stentoreus (and/or **arundinaceus**). The Great Reed-Warbler.

Status.—Three observations only. On 18 November 1935 a single bird (from absence of streaks below, probably *brunnescens*) was feeding in rushes on the Dalauk In. On 26 January 1936 a single bird was seen feeding in a small swamp near the Mon canals head. On 19 April 1936 a number of birds were seen uttering a harsh croak in bushes on Paunglin lake. They were not shy, and faint black streaks were observed on throat and breast.

Acrocephalus bistrigiceps. Schrenck's Reed-Warbler.

Status.—Identified once only, on 19 January 1936, when a number were seen among bushes and long grass at the edge of the Paunglin lake. The dark line above the white supercilium was clearly seen, distinguishing it from the Dusky Willow Warbler.

? Acrocephalus concinens (or **agricola**). The Paddyfield-Warbler.

Status.—Only one doubtful observation, on 5 November 1936 at Palandaw, when three small warblers, similar in size and shape to the Tenasserim Wren Warbler, were seen on top of a tall bush. This fact, combined with the brown upper plumage, pale streaks on wings, fulvous lower plumage, and faint supercilium indicate this species, although the pale streaks on the wings were more conspicuous than the F.B.I.'s 'obsolete pale edges' suggests.

Orthotomus sutorius. The Tailor-bird.

Voice.—On 28 April 1936 I saw a bird calling loudly for many minutes without a pause.

Habits.—Found in compounds, *ya* land, scrub and *indaing*. On 8 July 1936 I saw a party of at least 4 birds, none of them obviously young ones.

Nesting.—No nest found in the area, but on 11 August 1935 an agitated pair, with food in their bills, were seen in a bush in *indaing* jungle, evidently with young close by.

Status.—Common from June to September, uncommon from October to May.

Cisticola juncidis. The Streaked Fantail Warbler.

Voice.—I found the bird usually silent in the cold weather, but occasionally it called while in flight.

Habits.—Found mostly in lakes, paddy fields and *kaing*, but sometimes also on *ya* land. One fledgling was seen in a sessamum crop in August. I have seen numbers of birds soaring high and calling over the river bed at Minbu as early as the 1 March.

Nesting.—Nests were found on canal banks, in *kaing* cultivation, and in the sandy bed of the Irrawaddy. Once I saw material being taken to a patch of reeds. On 5 June 1936 a nest with eggs in the bed of the Irrawaddy had been submerged by the river, and another one was only just clear of the water. All nests I saw were of the long deep purse type. Sometimes the blades of the grass clump were tied together with cobwebs, and one at least with loose pieces of grass. The lining was always of very soft vegetable down, identified once or twice as silk-cotton. On 1 March 1936, in the bed of the Irrawaddy, I put up a fledgling, which one parent had just left, from *kaing* cultivation. It was just able to fly, and there was no doubt whatever of the species. The latest date on which I saw nests being built was 16 September.

The markings on eggs were always thicker at the blunt end and usually in a ring, but one egg found on 20 August 1936, in a nest with two young birds and one normal egg, was practically unmarked.

Status.—Common, or very common, from March to November, uncommon in December and January, not seen in February.

Franklinia gracilis. Franklin's Wren-Warbler.

Identification.—In summer, I always found the throat conspicuously white, by contrast with the grey pectoral band, and in winter the greater length of the tail was noticeable. The change of plumage takes place, however, very irregularly. On 12 January 1936 I saw a number of birds feeding in a bamboo clump near Minbu, some of which still had the breast band conspicuous and the crown greyer than the upper plumage. Even on 2 February 1936 one bird among several in a tree was still in that plumage, while most of the others, though they had lost the pectoral band, still showed greyer on the crown. A bird seen on 19 April 1936 had grey crown, brown upper plumage, and faint grey breast band, and was presumably in process of acquiring summer plumage. On the other hand, one bird at least among a number seen on 29 August 1935 was already acquiring its long winter tail, and another was losing its pectoral band.

Voice.—On 12 January 1936 I watched a number of birds feeding, and pausing periodically to utter a fairly loud cheerful little chattering song. On 10 March 1935 a bird was perching on bushes and singing hard, mostly a succession of two notes ending in a trill.

Habits.—Found mostly in scrub, also in compounds, *ya* land, and *indaing*. Usually in trees, but sometimes in bushes or bamboo clumps, and once I saw a single bird on a phone wire. (In the Shwebo district they were much less common and usually seen in paddyfields or swamps.) In the hot weather and rains they were usually seen singly, but in the cold weather in parties. I once saw a bird hanging upside down to feed.

Nesting.—No nests found, but a bird seen on 24 July 1935, perched in a hedge, was chattering very excitedly, as if with young.

Status.—Common in January and February, fairly so in March and April, commoner again from May to September, but uncommon October to December.

Franklinia rufescens. Beavan's Wren-Warbler.

Status.—On 16 August 1936 I saw numerous birds in small parties near Mezali headworks, which I took at the time for Franklin's Wren-Warblers in winter plumage. In view, however, of the time of year, they were probably this species.

Megalurus palustris. The Striated Marsh Warbler.

Identification.—Perches much more erectly than the Striated Babbler, from which it took me some practice to distinguish it.

Voice.—A young bird seen with its parents on 7 May 1936 was calling with a loud harsh 'chat'. An adult seen on 19 January 1936 was uttering a loud whistling call, and another on 1 March 1936 was whistling 'ŏh, whĕre ăre yŏu gŏĭng', with variations. I also saw one singing hard on the 19 June. All these were singing from conspicuous perches.

Habits.—Seen only on *ins* or *kaing* land. Usually solitary, but one November I saw a party of at least 5. A pair seen with a young one on 7 May 1936 were very bold and noisy.

Nesting.—No nests found, but birds appeared, from their behaviour, to be nesting on 7 May 1936 in thick *kaing* stubble in the river bed at Minbu, and on 1 March 1936 in island crops near by.

Status.—Only seen 7 times, none of them in the period July to September, but locally common.

Phragmaticola aëdon. The Thick-billed Warbler.

Status.—Only one doubtful observation, on 19 January 1936, when a bird was seen feeding on insects in bushes and long grass at the Paunglin lake. The stout bill, dark eye, and apparent absence of supercilium indicated this species, but the voice (a harsh frog-like croak and a rattle) and the white edge to the tail tallied better with the Great Reed-Warbler.

? Phylloscopus schwarzi. Radde's Willow Warbler.

Status.—I saw a solitary bird on 1 May 1935 in the compound of Kyitkaing inspection bungalow, at the edge of jungle, which was apparently this species. It was hopping about the ground feeding.

The length was about 5″, the tail being shorter than the wing and square. Upper plumage and tail were all olive-brown, with darker streaks in the wing. Supercilium and lower plumage fulvous. No other species appears to answer this description.

Phylloscopus affinis. Tickell's Willow Warbler.

Identification.—Upper plumage always appeared to me brown, not green.

Status.—Three observations only, all between 16 December and 2 February. On the first occasion a single bird was flitting among a bean crop near the Salin canal head, hawking insects. The white supercilium was conspicuous. On the second occasion a solitary bird was feeding actively in a bush alongside a stream in scrub jungle near Minbu. The long white, or pale yellow, supercilium and all-yellow lower plumage were noted. A few weeks later two birds were seen hopping actively about bamboos in the same place, flirting their tails constantly. A very detailed description was recorded, which leaves me in no doubt of the species.

Phylloscopus fuscatus. The Dusky Willow Warbler.

Voice.—One bird I saw was calling softly, like a chat.

Habits.—Seen once near a stream in scrub jungle, but usually at lakes. Once seen on the ground, and once in a tree, otherwise always in bushes or rushes. It catches flies very actively and flirts its tail.

Status.—Except for one doubtful observation on 19 April 1936, the bird was only seen in November and December.

Prinia flaviventris. The Yellow-bellied Wren-Warbler.

Status.—Seen twice only, on 14 February 1935 among bushes near the Man river at Aingma, and on 15 March 1936 in *kaing* grass at an *in* near the tail of the N. Mon canal. One bird had conspicuous white supercilia, the other had not.

Prinia inornata. The Tenasserim Wren-Warbler.

Habits.—Found mainly in paddyfields and at lakes, but also in *kaing* and *ya* cultivation. I have seen a bird in June singing loudly and shivering its wings in the presence of another presumably courting.

Nesting.—On 4 March 1936, in the bed of the Irrawaddy at Minbu, birds were evidently breeding in *kaing* cultivation. Judging from their agitation, they apparently already had young. On 20 June 1935, at Pwinbyu, birds were very numerous in small swamps, but, though courting was observed, there was no sign of nesting—possibly owing to the very late arrival of the rains that year, paddy-fields being still dry. On 10 June 1936, at the Wethigan lake, Salin, I found a nest in a clump of floating grass 100 feet from the shore, containing 4 young just hatched.

Status.—Common or very common from June to September and fairly so in October, but uncommon in other months.

Oriolus chinensis. The Black-naped Oriole.

Voice.—Once in August I saw a female, which was with a young bird in a tree, calling raucously the Morse letter F. (. . – .).

Habits.—Seen in compounds, *indaing* and scrub, and at lakes.

Status.—Observed in all months, but never common. Less uncommon from January to May than during the rest of the year.

Oriolus xanthornus. The Black-headed Oriole.

Status.—Only seen twice in the area. On 2 November 1935 a female or young bird (probably the latter) was seen in a tree in scrub jungle near Minbu, in company with a male Koel. On the 15th of the same month I saw an adult male calling in a *kokkobin* in the inspection bungalow compound at Shauktaw.

Strnuia malabarica. The White-winged Mynah.

Habits.—Seen in *indaing, ya* land, bungalow compounds, and on canal banks. Usually in trees, but twice seen feeding on the ground, and once perched on a telephone wire. Usually in flocks, but singly or in pairs in the breeding season. Seen feeding on flowers of cotton-tree and *thimbaw kokkobin,* the former attracting a large flock.

Nesting.—Only nest seen was in a hole 15 feet up in a rotten branch of a *thimbaw kokkobin* in the compound of Kyitkaing I.B., S. Mon canal. On 17 May 1935 it contained two young birds.

Status.—Uncommon. Only 6 observations in the area, 5 of which were between 26 November and 17 May. The remaining one was on 19 August.

Gracupica nigricollis. The Black-necked Mynah.

Status.—Only seen once in the area, on a lake in February.

Gracupica burmanica. Jerdon's Mynah.

Habits.—Seen mostly in scrub jungle and *ya* land, but also in *indaing kaing* cultivation and on lakes. On 6 April 1936 I saw a flock of several hundreds, with a smaller number of Jungle Mynahs, a few Pied Mynahs and some Weaver-birds in bushes in the river bed at Minbu. The chatter was quite deafening. On another occasion, in February, I saw a flock of 100 or more roosting in a tree.

Nesting.—Not observed, but a pair were feeding fledglings on 16 June 1936.

Status.—Very common all the year.

Acridotheres tristis. The Common Mynah.

Habits.—Seen mostly in towns and villages, also in bungalow compounds, *ya* land, river beds and at lakes.

Nesting.—On 17 May 1935, a pair were making a nest of sticks inside a hole 15 feet up in a tamarind, which had recently contained young Spotted Owlets. The Mynahs, however, did not lay. On 8 July 1935 a pair were feeding young in a hole in another tamarind, and on 13 May 1936 young were being fed in a hole 25 feet up in another tree. The last-named date appears to be early for breeding. All the above were in or just outside my compound at Minbu.

Status.—Very common all the year.

Æthiopsar fuscus (and ? **Æ. cristatellus**). The Jungle Mynah.

Identification.—Birds of two very distinct types occur in this area, as in Shwebo. The one with browner upper plumage, paler bill and legs, and smaller curl of feathers above the nostril, which I had always taken for the Indian race, is much the commoner of the two in Minbu, whereas in Shwebo the darker colouration and more pronounced curl, which I always regarded as the Siamese Mynah, was the commoner. Moreover, at the foot of Mt. Victoria in December 1935 I found all birds to be of the darker type, contrasting strikingly with Minbu. These facts and those recorded in my Shwebo notes (Vol. 48, p. 522) make me wonder whether the difference is not, in fact, one of race, not of age. If so, the Siamese race is the commoner of the two in the Shwebo area.

Habits.—Found in villages, *ya* land, scrub jungle, river beds and at lakes. A very large mixed flock of this species and Jerdon's Mynahs were roosting in bushes in the Mon river bed at Mezali in October 1935.

Status.—The paler form (? Indian race) was common from January to May, and very common in all other months. The darker form (? Siamese race) was only seen in February.

Sturnopastor contra. The Pied Mynah.

Habits.—Most often seen round lakes, but also in compounds, *ya* land, scrub jungle, canal and river beds. On 4 August 1935, at the Paunglin lake, birds were very numerous, both in pairs and flocks. On 6 April 1936, several pairs were with a very big flock of Jerdon's and Jungle Mynahs in the river bed at Minbu.

Nesting.—No nest seen in the area, but on 13 May 1936 a bird was seen in flight with either food or nesting material.

Status.—Common, or fairly so, throughout the year; much commoner than in Shwebo.

Ploceus passerinus. The Eastern Baya.

Habits.—Found in villages, *ya* land, river beds and at lakes. On 19 April 1935 innumerable flocks were flying eastwards down the Sabwet *chaung,* near Minbu, all stopping to rest on the same tree.

Nesting.—Nests were constructed annually hanging from the eaves of the Irrigation S.D.O.'s quarters at Shauktaw. In July 1935 I counted 32 either under construction or recently finished. In November they were all removed, but by 5 July 1936 a number were again under construction. These included one nest of three tiers, proving that these multiple nests are not always the result of hanging new nests below old ones. The two upper 'stories' were, however, badly shaped, without proper egg chambers. As usual there was no opening from the bottom storey to the one above it.

In August 1935, in *indaing* jungle, I saw a solitary cock nest suspended 30 feet up over a tank. Other nests, of both kinds, had fallen to the ground, and, as usual, the finished ones contained no mud.

In November 1935 I saw 3 nests suspended from a 'phone wire —an unusual position.

On 3 May 1936, birds had begun to build among bushes on dry land near Minbu—another unusual position. In fact, although the birds were undoubtedly this species, they were starting to build nests which were not hanging, but more like those of the Striated species.

In August 1936 I saw a solitary 'hen' nest, containing 3 eggs, which did contain mud on the inside (on one side only). In my experience this is very unusual. The cock was still adding material to it.

On 11 June 1935, in a bush-covered swamp near Minbu, I saw work proceeding on a half-finished nest of the previous year, with a new nest being started alongside it.

Out of a colony of 8 nests seen on 24 June 1936 on the bank of a *chaung*, one was a finished 'hen' nest, with the female sitting, one was a finished 'cock' nest, and the other 6 were half finished. Each of the latter had a separate male at work on it, and there was no sign of any more females[1]. They all had mud on the inside, so were probably all destined to be cock nests. One of them was suspended from two points, instead of from the usual single point.

Status.—Very common June to September, uncommon in other months.

Ploceus manyar. The Striated Weaver-bird.

Habits.—Found only on lakes. Very large numbers bred on the Wethigan lake, Salin. I have seen males displaying by hopping about the rushes and flapping their wings. Females sit tight, and sometimes do not leave the nest until it is touched.

Nesting.—Nests only found in rushes. In August 1935, on the Paunglin lake, I found a nest, with eggs, surrounded by old cock nests, without a single other new nest in sight.

The material was sometimes stolen from other nests, but usually stripped off the rushes. All cock nests seen had mud or dung plastered on the inside of the back rim, but the only 'hen' nest I ever saw with mud adhering had some plastered at the bottom on the outside.

As with the Bayas, I found that the males did all, or nearly all, the work of building, while the females sat and watched, occasionally visiting the nest to inspect progress.

The earliest I saw young birds was 25 June. Many nests were still under construction on 24 August 1936.

Status.—Very common from June to September. Not observed in other months.

Ploceëlla chrysaea. The Golden Weaver-bird.

Status.—Never seen in this area.

Munia atricapilla. The Chestnut-bellied Munia.

Habits.—Seen mainly in lakes and paddyfields, but also in river beds. On 9 June 1936 enormous numbers were feeding in the ripening *mayin* paddy round the Paunglin lake.

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[1] For an explanation of the so-called 'Cock nests' and the absence of females in the early stages of nest building see Sálim Ali—The Nesting Habits of the Baya, *Jour. B.N.H.S.*, **34**: 947-964 (1931)—Eds.

Nesting.—On 13 October 1935 I saw two nests in rushes at the Paunglin lake. One was two feet above the water, made of feathery grass, with the rushes bent all round it. It contained only two eggs. The other was made of straw, and little use was made of the growing rushes. This one only contained three eggs. On the following day I saw a bird fly off from another nest in the rushes which had just been begun.

Status.—Common from June to November, uncommon during the rest of the year, when I only saw it in February and April.

Uroloncha striata. Hodgson's Munia.

Status.—Never seen in this area.

Uroloncha punctulata. The Spotted Munia.

Identification.—Young birds take many months to acquire adult plumage. Out of a party of 6 or more young seen on 25 March 1935, only one had any trace of spots on the lower plumage or of the dark throat.[1]

Habits.—Seen mostly in paddyfields and *ya* land, but also in river beds, scrub jungle, lakes and *kaing* cultivation. On 9 June 1936, there were enormous numbers in the ripening *mayin* paddy round the Paunglin lake. On 28 August 1936, I saw a flock of more than 15, in an area where there were many nesting birds.

Nesting.—The earliest date I found eggs was 18 August, and the latest I saw nestlings 25 October. All nests seen were in bushes or thorn trees, usually in scrub, jungle, and upto 6 feet from the ground. Some were made mainly of strips of bamboo leaves or similar material, with grass bents on the outside. One was made of straw, and in another case two nests had been made of twigs and straw in a single lump of rubbish. A soft grass lining was usually, but not always, present.

One bird sat so tight that it did not move even when I shook the bush and poked the nest, but only when I started to insert my hand. The largest clutch seen was 6 eggs. One clutch was in process of hatching on 7 October 1935, and the nestlings were about ready to fly on 25 October, giving a fledging period of 18 days. On the latter date I handled one of the nestlings, and on 2 November found a nestling's skeleton in the otherwise empty nest. Possibly as a result of my handling the parents had refused to feed it. (? !—Eds.) I twice found nests with two bad eggs among their contents; they seem to be common.

On one occasion I accidentally broke one of 5 eggs inside a nest, but the mess did not deter the bird from returning to sit on the others.

Status.—Common, or fairly so, in all months.

Amandava amandava. The Red Munia.

Identification.—On 27 January 1935 I saw a male with under tail-coverts red, not black as described in F.B.I. I had noticed the same fact previously in Shwebo in September. One bird in a flock seen on 23 February 1936 had acquired the pink breast of breeding plumage. The remainder showed no red, even on the rump, and were presumably young birds of the previous year. Again, of a party of 5 birds seen on 15 March 1936, only one showed any red. On the other hand, ten birds seen on 27 April 1936 all showed red on rump and upper tail coverts, bill and legs, and nowhere else.

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[1] The non-breeding adult plumage of this munia is plain brown as in the juvenile, with unspotted underparts.—Eds.

Habits.—Found on lakes and rivers, in *kaing* cultivation and paddyfields, and in the *tazé* area (dry except in high Irrawaddy floods). Usually clinging to tall grass or rushes, but sometimes feeding on the ground. I saw them in flocks as late as 20 June, and once saw a pair by themselves on 27 January.

Status.—Noted as especially common in June, and especially uncommon in November and December.

Passer domesticus. The House Sparrow.

Habits.—Seen mostly in villages, also in river beds and at lake sides. More than once, I have seen it among paddyfields, a mile or so from any building. It consorts and nests with Tree Sparrows.

Nesting.—In January 1936 I found birds nesting in holes, probably old Sand Martins, in the vertical bank of the Mon river.

Status.—Common to very common all the year, but not so plentiful as the Tree Sparrow.

Passer montanus. The Tree Sparrow.

Nesting.—I once saw a pair building inside the bamboo mast of a country boat, which was temporarily moored. On another occasion, in August, many birds were flying in and out of Sand Martins' holes in the bank of the Irrawaddy, the latter species also being present.

Status.—Very common all the year. Far more common about buildings than it was in Shwebo.

Passer flaveolus. The Pegu House Sparrow.

Habits.—Seen mostly in scrub jungle, also in *indaing, ya* land and villages.

Status.—Very common in March and April, common from May to August, fairly common or uncommon from September to February.

Emberiza aureola. The Yellow-breasted Bunting.

Habits.—They sometimes feed in company with House Sparrows.

Status.—Only seen 4 times in this area, twice in April and twice in November. Possibly, therefore, they only pass through it on passage.

Riparia riparia. The Eastern Sand Martin.

Status.—On 7 May 1936 a flock of some hundreds was flying about over the Irrawaddy bed at Minbu, drinking on the wing from the pools. A number of birds were seen there again a week later, flying north. No other observations.

Riparia paludicola. The Indian Sand Martin.

Habits.—Found mostly in river beds, also in *ya* land and paddy-fields.

Nesting.—All young had flown from a nesting colony at Minbu by 18 March 1935. On 31 March 1935 nestlings were still being fed in a colony on the R. Man, while on 24 March 1936 some eggs in another colony were still unhatched.

I have seen nesting holes dug dead straight for at least 2′ 6″, even in a bank of heavy shingle and boulders.

Status.—Common, or fairly so, from April to September, very common from October to March.

Hirundo rustica [gutturalis Scop.] The Eastern Swallow.

Habits.—An uncommon habit is to hover low above water, catching insects. I have seen both individual birds and flocks doing this.

Status.—I found it common in the area in July. On 1 July 1935 several flocks were seen on 'phone wires, and 11 days later a large flock was flying in leisurely and straggling fashion down the Irrawaddy at Minbu. In the following year, too, birds were recorded as very numerous on 8 July and for several days previously. On 23 April 1936 enormous numbers were hawking along a canal bank, under mango and other trees, no doubt preparatory to departure; but they were still common in May, and occasionally seen in June.

Hirundo rustica tytleri Jerdon. Tytler's Swallow.

Identification.—The amount and depth of chestnut on the lower plumage varies considerably in different individuals. Some seen on 6 March 1936 among a large flock of Eastern Swallows had the lower plumage entirely chestnut, others only partly so, and the depth of colour varied. Another seen on 24 April 1936, also among Eastern Swallows, had the lower plumage below the collar white except for a small chestnut patch. Two seen on 19 December 1936 had only a chestnut tinge.

Status.—Seen in every month from November to April, but uncommon.

Hirundo smithii. The Wire-tailed Swallow.

Status.—Only seen along canals. Fairly common February to April, never seen May to July, uncommon August to January. Earliest date August 10.

Hirundo daurica. The Striated Swallow.

Identification.—Apart from the distinctive features given in B. of B., it appeared to me larger than the Eastern Swallow, when they were seen together.

Habits.—Remarkably tame. A large flock resting on a sand-bank once allowed me to approach within ten yards in full view. I saw them in *ya* land, *indaing* and scrub jungle as often as over river beds and lakes.

Status.—Winter visitor, probably all Hodgson's race (*japonica*). Latest date 5 April 1936.

Motacilla alba [ocularis Swinhoe.] The Streak-eyed Wagtail.

Status.—Only seen once, a solitary bird in the river bed at Minbu on 15 January 1937. Identified by black eye-stripe.

Motacilla alboides. Hodgson's Pied Wagtail.

Status.—Three observations in the area, at Konzaung on 26 January 1935, at Shauktaw on 12 October 1936, and at Mon canals head on 8 November 1936. All were solitary birds. Identified by black ear-coverts and sides of neck.

Motacilla leucopsis. The White-faced Wagtail.

Identification.—Several times I saw young birds with very conspicuous white patches on the wings.

Status.—Earliest date September 14. Becomes common by the end of September, very common October to February, still common in March, uncommon in April. Latest date April 25.

Motacilla cinerea. The Eastern Grey Wagtail.

Status.—Uncommon in this area, only observed in January and February.

Moatcilla flava. The Grey-headed Wagtail.

Habits.—Seen mostly at lakes and in river beds, but also in compounds along canals and in *kaing* cultivation. In the last-named habitat, I once saw a flock of 20 perched on *pyaung* plants. In early April, I saw them in large flocks, no doubt preparing for migration.

Status.—Earliest date September 13. Very common September to April. Latest date April 28.

Motacilla citreola [citreola Pallas.] The Yellow-headed Wagtail.

Identification.—On 15 November 1936 I saw a bird at Paunglin lake with the whole head, except the crown, still in the bright yellow of breeding plumage.

Habits.—Never seen away from river beds and lakes.

Status.—Earliest date October 21, uncommon until January, fairly common in that month, common February to April. Latest date April 25.

Motacilla citreola [calcarata Hodgs.] Hodgson's Yellow-headed Wagtail.

Status.—An adult male in full breeding plumage was seen in a *mayin* field at Paunglin lake on 19 April 1936. Identified by the black back.

Anthus hodgsoni. The Indian Tree Pipit.

Habits.—Seen mostly in compounds and on *ya* land, also in villages.

Status.—Earliest date November 5. Fairly common to very common from November to February, uncommon in March and April. Latest date April 23.

Anthus similis. The Brown Rock Pipit.

Habits.—Only seen in open scrub jungle.

Status.—Uncommon. Seen in January, August, September and October.

Anthus richardi. Richard's (? or Blyth's) Pipit.

Status.—Only two good identifications, one on 27 January 1935, the other on 2 February 1936.

Anthus rufulus. The Indian Pipit.

Identification.—A bird I saw on 2 October 1935 in thin scrub jungle showed bright orange legs.

Habits.—Seen mostly on *ya* land, also in villages, river-beds, *kaing* cultivation and scrub jungle. On 24 June 1935, I saw an apparently adult bird being fed with a large caterpillar by another one.

Status.—Fairly common in June, common to very common in other months.

Anthus cervinus. The Red-throated Pipit.

Status.—Very uncommon. Only two good observations, both in the river-bed at Minbu, in March 1935 and January 1936. In each case two birds were seen among low cover, the reddish or pink tinge on the lower plumage, and in one case on the side of the head also, being evident. From the location, probably this species, not Hodgson's.

Alauda gulgula. The Small Skylark.

Identification.—I found the crest, often very distinct, the clearest feature by which to distinguish it from the Bush Lark.

Habits.—Seen mostly on *kaing* land and in the *tazé* area; also on *ya* land. When soaring high, the song is in my opinion almost equal to that of the British Skylark.

Status.—Common in December and January.

Calandrella brachydactyla. The Rufous Short-toed Lark.

Status.—On 5 June 1936, I saw 8 to 10 birds running about an island in the river-bed at Minbu, probing the sand. They were the size and shape of Ganges Sand Larks, and were behaving in just the same way. The upper plumage, however, was browner, and the outer tail feathers white at the base. Lower plumage was whitish and some had dark grey patches on the breast. The bill was yellow-brown and the legs yellow-brown or reddish-brown. Judging from the plumage, probably this species.

Calandrella raytal. The Ganges Sand Lark.

Identification.—They sometimes show a distinct crest, even out of the breeding season.

Voice.—I have heard it, in October, uttering a plaintive two-syllable call, and in March singing better than a Bush Lark.

Habits.—When courting, the male erects his crest, bows, and flaps his wings.

Nesting.—I found a nest in the river-bed at Minbu on 17 May 1935. It contained one nestling and one egg. It was a hole 2″ deep under a thistle, lined with straw.

Status.—Uncommon July to September, owing no doubt to the rivers being high, but common to very common the rest of the year.

Mirafra assamica. The Bush Lark.

Habits.—Seen mostly in scrub and *ya* land, but also in *indaing* and river-beds. I once saw a male displaying to the female, who was working on the nest, by the usual song flight, and then, on alighting, by walking slowly sideways, shivering his wings. I have seen it perch as high as about 25 feet, on top of a tree. Occasionally they lie very low in cover and, when put up, come down again within a few yards, like a quail.

Status.—Common from December to May and very common from June to November. Many nests found.

Cinnyris asiatica. The Purple Sunbird.

Habits.—Seen mostly in *indaing* jungle, but also in scrub and occasionally in bungalow compounds. Never common in this area, but least uncommon between February and May.

Dicaeum cruentatum. The Scarlet-backed Flowerpecker.

Voice.—The call while flying is much like that of the Streaked Fantail Warbler.

Habits.—I have seen it hawking flying insects from a perch in a tree, and then, for 10 minutes or more, remaining absolutely motionless under a leaf.

Status.—Only seen twice in the area, in both cases solitary males. One was in thin jungle and dry cultivation on 22 November, and the other in *indaing* jungle on 11 August. On the latter occasion it was being chivvied by breeding Tailor Birds.

Picus viridanus. The Scaly-bellied Woodpecker.

Nesting.—The only nest which I saw in the area was lined with grass, straw and feathers. It was on a ledge inside a rotten branch, with the entrance hole some way below it.

Status.—Only seen three times, in August, November and December.

Picus canus. The Black-naped Green Woodpecker.

Status.—Only seen once, in *indaing* jungle near the Mon canals head.

Dryobates analis. The Pied Woodpecker.

Identification.—The pink under tail coverts were sometimes so pale as to be unnoticeable in the field.

Habits.—Seen in *indaing* jungle, along canal banks, and in bungalow compounds.

Status.—Uncommon. Only seen 5 times in the area, in February, March, April and August.

Dryobates mahrattensis. The Yellow-fronted Pied Woodpecker.

Status.—Only seen once in this area, on 23 February 1936 at Paunglin, when a male was drumming on a dead branch of a cactus tree in scrub jungle. It remained on exactly the same spot for at least 10 minutes.

Micropternus brachyurus. The Rufous Woodpecker.

Status.—Only one observation in the area, on 6 April 1935 on the Kalahaung distributary canal.

Iynx torquilla. The Wryneck.

Habits.—Seen in river-beds, paddyfields, *ya* land and scrub jungle.

Status.—Uncommon. Earliest date October 13.

Megalaima haemacephala. The Coppersmith.

Voice.—When calling, the bird jerks his whole body, especially the tail, at each 'tonk'.

Habits.—Seen along canals, on *ya* land and in villages.

Status.—Common in January, but less so, or even uncommon, in other months.

Cuculus canorus. The Khasia Hills Cuckoo.

Status.—Only seen once in this area, on 13 October 1935, when a single bird was perched on a small bush on the shore of the Dalauk *In,* Paunglin. It descended to the ground, then tried to perch in a tree, but was mobbed by drongos. Evidently a young bird, as the whole upper plumage was finely barred.

? Cuculus poliocephalus. The Small Cuckoo.

Status.—A cuckoo seen near Minbu on 3 May 1936 was about the size of the Plaintive Cuckoo, with plumage similar to that of the Khasia Hills species. A close view showed a red eye, with a yellow ring round it. It settled in a small tree, then descended to the ground. Apparently this species.

Cacomantis merulinus. The Plaintive Cuckoo.

Voice.—On 23 August I saw one, which was perched on a bush, utter once only a loud clear 3-syllable call.

Habits.—Found in scrub, *ya* land, paddyfields and at lake-sides, where I have seen it clinging to rushes and making sallies to catch butterflies.

Status.—Not seen between 18 April and 14 August. Uncommon during the rest of the year.

Clamator jacobinus. The Pied Crested Cuckoo.

Voice.—One of its calls, heard in July from a perch on a bush, was rather metallic and monosyllabic.

Habits.—Seen mostly on *ya* land, also in paddyfields and compounds.

Status.—Uncommon from May to September, not seen in other months. Earliest date 29 May.

Clamator coromandus. The Red-winged Crested Cuckoo.

Status.—Only seen five times, four of them between 17 July and 13 August, and the fifth on 26 January. Young bird seen on 13 August.

Eudynamis scolopaceus. The Koel.

Voice.—The bird calls occasionally in the rains, especially when the sun is shining, and in the cold weather, especially at dawn and dusk. I heard it in this area in every month except November. Once in July I saw a female uttering a whining cry, not unlike a Brahminy Kite's, and frequently repeated. In January I once heard the usual shrieking call being uttered very softly and quite melodiously.

Habits.—Seen mostly in villages, also in *ya* land.

Status.—Fairly common in January, very common February to June, uncommon July to October, and very uncommon in November and December.

Rhopodytes tristis. The Large Green-billed Malkoha.

Status.—Uncommon. Only six observations in the area, five of which were of solitary birds. Seen in April, May, August, September and November.

Centropus sinensis. The Crow-Pheasant.

Habits.—Seen mostly in scrub, also in river-beds and at lakesides. Once seen in a bush growing in the Paunglin lake. On 1 June 1936 I saw a pair mating high up in a mango tree. The male swore hard at the female before pursuing her and copulating.

Nesting.—Close to the above pair, 20 feet up at the end of a branch, was a big mass of leaves etc., which was probably the nest, though I was not able to investigate.

Status.—Common from March to September, and fairly so from October to February.

Psittacula eupatria. The Large Parrakeet.

Status.—Very uncommon in the area. Only seen once, on 15 April 1935, in a tree near the Salin canal head. Another bird was, however, seen a few miles outside the irrigated area, in *indaing* jungle between Aingma and Shwezettaw, on 16 February 1935.

Psittacula krameri. The Rose-ringed Parrakeet.

Habits.—Seen mostly along canals, also in paddyfields, villages, *ya* land and *indaing*.

Nesting.—On 24 January 1935 I watched several pairs examining holes in cotton trees standing in paddyfields. Each pair kept to itself, the female entering the hole while the male looked on.

Status.—Common, or fairly so, in all months except June and July, when it was uncommon.

Psittacula cyanocephala. The Blossom-headed Parrakeet.

Identification.—A young bird handled on 14 May 1935 still had the tail much shorter than the wing, but the plumage was colourful. Judging from the conspicuous maroon wing-spot, it was probably a male, but resembled a female in its bluish-grey head and absence of black or verdigris green. The lower mandible had turned black, but the upper one was still yellow, not orange, and the legs and feet were more grey than green.

Voice.—The call heard in flight sounded to me much the same as that of the rose-ringed species.

Habits.—Only seen, in, or close to, *indaing* jungle.

Status.—Only 3 observations in the area, on 11 August 1935, 26 November 1935, and 25 January 1936. On the last-named date, flocks were numerous.

Psittacula himalayana. The Slaty-headed Parrakeet.

Status.—Only seen once, on 26 January 1936, when numerous flocks were observed in *indaing* jungle near the Mon canals head.

Psittacula alexandri. The Red-breasted Parrakeet.

Status.—Never seen in the area—rather surprisingly, as I found them extremely common further up the R. Mon. They seem to avoid the plains more strictly than other parrakeets.

Coracias benghalensis. The Roller.

Habits.—Seen in scrub, *ya* land, compounds and at lake-sides.

Status.—Common, or fairly so, in all months except May, when I seldom saw it.

Merops orientalis. The Green Bee-eater.

Habits.—Seen in every type of terrain. Flocks roost in trees, groups of upto about 5 birds huddling close together on the perch like Ashy Swallow-Shrikes.

Status.—Very common all the year. Young birds seen at the end of May, but no nests recorded in the area.

Merops superciliaris. The Blue-tailed Bee-eater.

Habits.—Seen mostly at lakes, also in river-beds (both wet and dry), *ya* land and scrub. I once saw several birds, perched on a phone wire during a thunderstorm, which were spreading their wings and tails and leaning right forward, apparently to let the rain get under their feathers.

Nesting.—On 27 April 1936 a flock was starting to excavate nesting holes in the R. Mon bank at Pwinbyu. One bird was clinging to the vertical sand face, using its spread-out tail as a support, like a Woodpecker, while it worked.

Status.—Common April to September, uncommon in October, never seen November to March. Earliest date 18 April, latest 8 October.

Merops leschenaulti. The Chestnut-headed Bee-eater.

Status.—Only seen once in the area, on 18 October 1935, when several birds were hawking from trees on the Mon canal bank near its head. They were a most beautiful sight in the sun.

Ceryle rudis. The Pied Kingfisher.

Habits.—Frequents canals, rivers and lakes. I once saw a party of 13 birds perched on *kazins* at the shallow edge of Paunglin lake.

Nesting.—Nesting hole in Mon river bank seen in use on 12 October.

Status.—Fairly common to very common in all months except September, when I found it uncommon.

Alcedo atthis. The Common Kingfisher.

Habits.—Seen most often along canals and at lakes, but also along rivers.

Nesting.—Not observed.

Status.—It disappeared in April (latest 19 April), and did not reappear until August (earliest 4 August). It remained uncommon until October, when it became common or very common until the following April.

Ramphalcyon capensis. The Stork-billed Kingfisher.

Habits.—Found along canals and rivers, and at lakes. I once saw it perched on a phone wire along a main road—an unusually public position.

Status.—Very uncommon May to September, becoming a little commoner October to February, but never seen in March or April.

Halcyon smyrnensis. The White-breasted Kingfisher.

Voice.—On 22 March 1936 a bird settled high in a tree and uttered a shrill cackling whistle for a considerable time. Although the bird was very common, I think this was the only occasion on which I heard it utter a sound.

Habits.—Mostly along canals and at lakes, but also in river-beds and on *ya* land.

Status.—Very common October to February, not so common March to May, and even less so June to September.

Upupa epops. The Hoopoe.

Voice.—On 17 June 1936, in *indaing* jungle, I saw a party of four on a cart track, two of which were uttering a raucous call. Though full grown, I suspect that they were young ones calling for food.

Habits.—Seen mostly in scrub, also on *ya* land and in compounds.

Status.—Uncommon in May, fairly common June to September, common October to February, uncommon again in March, and never observed in April. Earliest date of return 19 May, which was 12 days before the rains broke that year (1935).

Apus pacificus. The White-rumped Swift.

Status.—Only seen twice within the limits of the area, on 6 September and 21 September 1935—single birds on both occasions. On 23 May 1936, however, I saw four birds at Nyaunghla, on the opposite bank of the Irrawaddy, and on 1 August 1936 four birds at Yenangyaung, close by.

Cypsiurus parvus. The Palm Swift.

Habits.—Seen in villages, *ya* land, river-beds and at lakes, sometimes out of sight of any palms.

Status.—Fairly common to common from February to April, seldom seen in May, common again June to November, but never seen in December or January.

Chaetura gigantea. The Brown-throated Spinetail.

Habits and *Status.*—Seen four times, in February and March, on 17 May and on 6 September. In March a single bird was hawking flies in company with Palm Swifts. The observation on 17 May was of a single bird over the river bed at Minbu, and that of 6 September of several birds in flight at Paunglin.

Hemiprocne coronata. The Indian Crested Swift.

Habits.—Seen over rivers, canals, lakes and *indaing.* On one occasion a flock was hawking insects low down in company with Sand Martins.

Status.—Observed in every month except January and October, and sometimes fairly common.

Caprimulgus macrourus. The Long-tailed Nightjar.

Status.—Only seen once, on 12 January 1936, when a bird was put up several times along a stream in scrub jungle near Minbu.

Caprimulgus asiaticus. The Common Indian Nightjar.

Voice.—In this area, birds called quite often during the rains, as well as in the dry weather. I heard them in August, September and October. One heard on 6 October gave a performance quite equal to dry weather standard. On the other hand they were comparatively silent from November to January.

Habits.—Found mostly near villages and in scrub, also in *indaing* jungle.

Status.—Common from January to June, less so in July, common or very common again from August to November, but never seen or heard in December in this area, though I did find it in that month up the valley of the Mon.

Lyncornis macrotis cerviniceps. The Burmese Great-eared Nightjar.

Status.—Only seen once, on 5 February 1935, when a bird entered my house at Minbu and was caught. A very strong west wind had been blowing the previous evening, which may have been responsible for the bird's presence so far from the jungle.

Tyto alba. The Barn Owl.

Voice.—On 29 June 1935, more than one bird in a banyan tree alongside Paunglin inspection bungalow was screeching loudly at dusk—probably young birds.

Habits.—Seen mostly in compounds, also in paddyfields.

Nesting.—A pair nested in the roof of the D.C.'s quarters at Minbu. Eggs were laid on a pile of disgorged pellets, etc. On 16 January 1935, the nest contained only two young and no eggs. One of the young left the nest on the 13 February, the other on the following day, giving a fledging period of at least 29 days. On 21 March 1935, two birds flew out of a hole in a cliff face on a *chaung* near Minbu. On 22 August 1936, a hole in the banyan tree at Paunglin (see above, under *Voice*) was occupied by 3 birds. It contained no eggs.

Status.—Fairly common in August and September, uncommon in other months, and never seen in May or July.

Athene brama. The Spotted Owlet.

Habits.—Seen in compounds and *ya* land.

Nesting.—The only nest seen was in a hole 15 feet up in a branch of a tamarind in my compound in Minbu. It was quite unlined. It contained two eggs on 16 March 1935 and three on the 28th. By 18 April two had hatched, the third having disappeared. The young birds, still in pure white plumage, fell out of the nest several times (from agitation at being discovered?) and I replaced them each time. By 17 May they had left the nest, which was being used by Common Mynahs.

Status.—Fairly common April and May, more common June to November, never seen in December, and uncommon January to March.

Pandion haliaëtus. The Osprey.

Status.—Seen three times, on 25 November, 14 December, and 6 March. One bird was fishing in the Irrawaddy, and another in Paunglin lake.

Torgos calvus. The Black Vulture.

Habits.—Found mostly in villages, also in scrub and river-beds.

Status.—Fairly common January to March, less so in other months.

Gyps indicus. The Long-billed Vulture.

Habits.—Found in villages, *ya* land and river-beds.

Status.—Fairly common throughout the year.

Pseudogyps bengalensis. The Indian White-backed Vulture.

Nesting.—Solitary nest seen on 17 February, in fork of cotton tree at the head of the Man canal, with one of the pair sitting.

Habits.—Mostly in villages, also in river-beds.

Status.—Fairly common all the year.

Falco peregrinus. The Eastern Peregrine Falcon.

Status.—Only seen once, on 3 January 1937 at Mon canals head, when a bird got up from the water's edge and settled in a tree. The white lower plumage, barred black, identified it as this race, not the Shahin.

Falco jugger. The Laggar Falcon.

Identification.—The black and white stripes on the head are a conspicuous feature in the field.

Status.—Four observations, in April, July, November and December. One was of a pair, the others of solitary birds. Two were perched on tree-tops, one flew up from the roadside into a tree, while the fourth was soaring over scrub jungle and sometimes hovering against the wind almost like a kestrel.

Falco tinnunculus. The Kestrel.

Habits.—Seen in scrub, *ya* land, *kaing,* and over lakes and canals. I once saw two birds on the wing catching flying ants with their claws and transferring each one as caught to their bills.

Status.—Uncommon. Seen in every month from November to March, but never in other months.

Aquila clanga. The Greater Spotted Eagle.

Status.—Only one good identification, on 8 December 1935, when a bird was seen circling over *kaing* cultivation near the Paunglin lake.

? Hieraëtus fasciatus. Bonelli's Eagle.

Status.—A bird seen circling over the R. Mon on 27 January 1936, and another seen to settle in paddy in the S. Mon canal area on 6 November 1936 were most probably this species.

? Spizaetus limnaëtus. The Changeable Hawk-Eagle.

Status.—In January 1936 birds were seen several times near water which were probably the melanistic form of this species.

Butastur teesa. The White-eyed Buzzard Eagle.

Habits.—Found mainly in scrub, but also in *ya* land, paddyfields, and at lakes.

Status.—Common, or fairly so, from August to November, uncommon from December to July, but observed in all months except May.

? Butastur liventer. The Rufous-winged Buzzard-Eagle.

Status.—One doubtful observation, on 14 February 1935, when a bird was seen in a tree close to the R. Mon.

? Ichthyophaga sp. The Grey-headed Fishing-Eagle.

Status.—On 13 January 1935, a bird was seen flying over the Irrawaddy bank near Minbu, which was probably this species.

Haliastur indus. The Common Brahminy Kite.

Habits.—Found only in river-beds and at lakes. It seemed to avoid the canals.

Nesting.—The only nest seen was on 23 February 1935, high up in a cotton tree standing in paddyfields, with one of the pair sitting.

Status.—Common, or fairly so, throughout the year.

Milvus migrans [govinda]. The Common Pariah Kite.

Nesting.—Observed in January and February, twice in a cotton tree, once in a Burmese *kokkobin.*

Habits.—Seen mostly in villages, also in *ya* land, river-beds, and at lakes.

Status.—Earliest date September 22. Very common October to February, common March to May, uncommon in June. Latest date 24 June (1935), when a single bird was seen in flight at the Wethigan lake, Salin.

Elanus caeruleus. The Black-winged Kite.

Habits.—Seen in paddyfields, *ya* land, scrub, *indaing,* and at river and lake sides. I have seen it hovering for several seconds, without moving its wings, like a kestrel.

Status.—Not uncommon in August (earliest 4 August), September and October, for which months I have a record of 9 observations, but only seen once outside those months, viz: on 1 February 1935.

Circus macrourus. The Pallid Harrier.

Status.—Three observations, on 18 November 1935, 24 January and 5 February 1936. All were adult males, and the pale grey upper plumage with black wing tips was distinctive. One bird was in flight over the Dalauk *In,* another was feeding on a small bird in the dry bed of the Salin canal, while the third was quartering over the Minbu golf-course.

Circus melanoleucus. The Pied Harrier.

Habits.—Mostly on *ya* land, also in *kaing* cultivation, paddyfields river-beds and at lakes.

Status.—Earliest 9 October. Common October to March, and fairly so in April. Never seen in May, but I did see a bird once on the 20 June. Birds still in juvenile plumage were seen as late as the 15 March.

Circus aeruginosus. The Marsh Harrier.

Habits.—Seen only at lakes, usually hunting over the marshy land or *mayin* paddy at their edges.

Status.—Observed from October (earliest 14 October) on to April, but never common. Latest date 19 April, when an adult male was seen hunting over *mayin* paddy at Paunglin lake.

Astur badius. The Shikra.

Identification.—The white bases of feathers showing through on the nape of the young bird make a conspicuous white patch, similar to a White-eyed Buzzard's.

Voice.—Once, in June, I saw two birds calling with a whining note, not unlike a Brahminy Kite's.

Status.—Uncommon. Only five certain observations, all between 14 June and 5 November.

Accipiter nisus. The Sparrow-Hawk.

Status.—Only seen once, on 16 December 1934, when a bird was in flight at the head of the Salin canal.

Crocopus phoenicopterus. The Green Pigeon.

Habits.—Seen in paddyfields, *ya* land, scrub and *indaing*. Once in November, I saw a flock drinking at the water's edge of a canal, and picking food off the surface of an adjoining *in*. Otherwise I only saw them in flight or in trees.

Status.—Never seen from March to August. Earliest 20 September. In the cold weather it was very variable in its occurrence, being common at times and uncommon at others.

Streptopelia chinensis. The Spotted Dove.

Habits.—It mostly favoured *ya* land and lake sides, but was found also in paddyfields, river-beds, scrub and *indaing*. On 4 August 1935 there were swarms of birds among the *mayin* paddy stubble round the Paunglin Lake, and on 12 October 1935 the bushes growing in the lake were full of them.

When making love, the male bows and coos, and the two rub bills.

Nesting.—Nests found in January, February, April, July, November, and December, generally 4 to 5 feet up in a hedge, once only 18 inches up, and once on the ground under an overhanging rock. These low nests contained more material than the others. Always two eggs.

Status.—Very common throughout the year.

Streptopelia decaocto. The Ring Dove.

Habits.—Found mostly in *ya* land, also in scrub, *indaing* and river-beds, and along canals.

Status. Common from December to March, uncommon in other months. On 14 December 1934 ripening paddy near Mon canals head was swarming with birds.

Œnopopelia tranquebarica. The Red Turtle Dove.

Habits.—Mainly in *ya* land, also in scrub, *indaing*, and river-beds, and along canals.

Status.—Common, or fairly so, from January to June, less so during the rest of the year. Not seen in July or December.

Gallus gallus. The Junglefowl.

Habits.—Seen mostly in *indaing* jungle, sometimes in scrub.

Status.—Common, or fairly so, from December to April, very seldom seen during the rest of the year.

Coturnix coromandelica. The Black-breasted Quail.

Habits.—Found in *ya*, scrub and *kaing* land. On 3 May 1936 there were large numbers of birds in the thin scrub and *ya* crops round the edge of the Minbu golf-course. They were mostly in parties of 3 or 4. One party of 3, well seen, comprised two birds with a black breast, and one without it—perhaps a young bird of the previous year.

Nesting.—On 9 June 1936 a bird was put off a nest in scrub jungle at Paunglin. The nest was an unlined scrape under a small plant and contained 4 eggs. They had a stone-coloured background and dark brown blotches at the large end. The date appears unusually early.

Status.—Very common from July to February, rather less so from March to June (but see observation of 3 May, described above).

Francolinus pintadeanus [phayrei]. Phayre's Burmese Francolin.

Habits.—Found mostly in scrub, also in *ya* land and *indaing* jungle.

Status.—Common from April to June, seldom seen in July, then fairly common from August to March. Female with two young seen on 28 August.

? Rallus aquaticus. The Indian Water Rail.

Status.—A rail was seen at the Paunglin lake on 19 January 1936. It swam into the rushes and sat very close. In size it was about the same as a Moorhen, perhaps a little smaller, and the plumage appeared all dark brown. Apparently this species, not *striata*.

Porzana pusilla [pusilla]. The Eastern Baillon's Crake.

Status.—Only seen once, on 22 February 1935, when a live bird, which had been netted on Wethigan lake, Salin, was brought to me. It had acquired adult plumage, but still had the red-brown eye of a young bird. It was said to be common in the *ins* near Salin.

Amaurornis phoenicurus. The White-breasted Waterhen.

Habits.—Seen mostly along canals, also in stream beds, paddyfields and scrub.

Status.—Common from March to May, seldom seen the rest of the year.

Gallinula chloropus. The Indian Moorhen.

Habits.—Only seen on lakes. Once in November, I saw two birds on an open *in*, with no cover round it, and once saw a young bird walking about on lily leaves like a Jacana.

Status.—Very uncommon in the area, and never seen from May to October. On 13 April 1935 I saw a number of birds on a small *in* alongside the Salin canal—an unusual sight in this area.

Gallicrex cinerea. The Watercock.

Identification.—During the rains, when the male had a pink or red horn, his bill was usually yellow, not red.

Habits.—Seen in paddyfields and lakes. One June I saw a male perched nearly at the top of *mayin* paddy stalks—an unusual position.

Status.—Fairly common from June to September, very uncommon in October and November, not seen December to February, uncommon from March to May.

Porphyrio poliocephalus. The Indian Purple Moorhen.

Habits and *Status*.—Only seen on the Wethigan and Paunglin lakes —both large sheets of water. From January to April a flock of up to 60 or more was always to be seen at a particular spot at the edge of Wethigan lake, close to Salin town and alongside a busy road. They used to feed among water hyacinth, and I was informed that their food consisted of insects. They were seen in smaller numbers at the edge of the Paunglin lake in June, November and December. Never seen from July to October.

Fulica atra. The Coot.

Status.—Never seen in this area.

Metopidius indicus. The Bronze-winged Jacana.

Habits.—Confined to lakes. It usually kept apart from the Pheasant-tailed species, but I once saw a single bird among about 30 of the latter.

Status.—Common, or fairly so, from April to August, less common September to March.

Hydrophasianus chirurgus. The Pheasant-tailed Jacana.

Habits.—Confined to lakes.

Status.—Unlike the Bronze-winged, it was more common in the dry weather than during the rains.

Burhinus oedicnemus. The Indian Stone-Plover.

Status.—Only one good observation, on 22 April 1935, when a single bird was seen on the bank of the S. Mon canal. On 9 June 1936, in scrub jungle near Paunglin lake, six birds, which were almost certainly this species, got up with a loud alarm whistle.

Esacus recurvirostris. The Great Stone Plover.

Status.—Only seen on 6 March 1936, when two birds were seen, a mile apart, on mud and sand banks in the bed of the Irrawaddy. One of them was behaving as if breeding.

Glareola maldivarum. The Large Indian Pratincole.

Status.—Only seen on the 29 and 30 June 1935, at Paunglin lake. Three solitary birds were seen, in flight and on mud at the edge of the lake, and also a flock of 30 to 40 standing head to wind in a wet field. At least half the flock were young birds, with mottled upper plumage and no cheek-stripes.

Glareola lactea. The Small Indian Pratincole.

Habits.—Seen mostly in river-beds, but also hawking flying insects over lakes, paddyfields, and even *ya* land.

Status.—Never common, least so from July to December.

Larus brunnicephalus. The Brown-headed Gull.

Status.—Only seen twice, on 21 October 1935 and 15 November 1936. On the first date three birds were flying down the R. Mon at dusk; on the second occasion a single bird was fishing in the Paunglin lake, and standing at the water's edge near Paunglin village. It was very tame.

Chlidonias hybrida. The Whiskered Tern.

Identification.—As in Shwebo district, the bill sometimes appeared black, not red. Possibly these birds were White-winged Black Terns, whose bill, according to F.B.I., is darker in winter.

Habits.—Found on lakes and rivers. One day on the Wethigan lake I saw a flock settle several times on water-lily leaves.

Status.—Rather uncommon November to April, never seen May to October.

Sterna aurantia. The Indian River Term.

Habits.—Seen only on rivers and lakes. On the Paunglin lake I once saw three birds flying about in a deluge of rain with their bills pointing upwards, as if catching the rain. On another occasion a bird dropped a fish which it was carrying five or six times and caught it again in the air, possibly to get it into a good position for swallowing.

Status.—Common or very common November to July, but very seldom seen in August, September, or October.

Sterna melanogaster. The Black-bellied Tern.

Identification.—I saw birds in non-breeding plumage as early as 15 March. A bird with white belly, probably a young one, was seen as late as 7 December.

Habits.—Seen on lakes as well as rivers.

Status.—Common from November to June, never seen between 24 June and 17 October.

? Sterna hirundo [tibetana]. The Tibetan Tern.

Status.—On 21 February 1936 I had a good view of a solitary bird standing in the river bed at Minbu. It was the shape of the Black-bellied species, with long forked tail, and appeared much the same size. The crown was black, the upper plumage pale grey, the lower plumage white, and the bill conspicuously bright red. I conclude that it can only have been this species.

Sterna albifrons. The Ternlet.

Habits and *Status.*—Only seen four times, always on the Irrawaddy. One observation on 6 March and two in May were of single birds. Another, on 26 May, was of a flock. One of the single birds was hovering over the water just like a Pied Kingfisher.

Rhynchops albicollis. The Indian Skimmer.

Habits and *Status.*—Only seen on 6 June 1936, on the Irrawaddy. Two birds were seen flying downstream along the water's edge, against the breeze, fishing. They flew back at a height of 20 feet or so, turned and went downstream fishing again. This performance was repeated several times. Later in the day four birds were seen flying about over the river.

Leucopolius alexandrinus. The Kentish Plover.

Status.—Only one good observation, at the Dalauk *In* on 23 February 1936, when a flock of 30 were seen on the shore. The black legs were clearly visible. They were feeding by scratching[1] the mud with their feet and listening.

Charadrius dubius. The Little Ringed Plover.

Identification.—Young birds are liable to be mistaken for Kentish Plover as the brown collar is sometimes not complete, even as late as the middle of January. The yellow legs, if seen, are distinctive. On the other hand I have seen a fledgling, not yet able to fly, with the brown collar already complete.

Habits.—Seen at river and lake sides. When still very small, the young birds run about nearly as fast as the parents. A peculiar method of feeding was noticed on one occasion. Birds were running about on the scum at the edge of a jheel, stopping frequently to scratch[1] it with one foot, and sometimes following this with a peck at a spot an inch or two ahead. Adults and young birds tend to congregate separately. On 14 October 1935 I saw numbers of young birds (no black on head and with the collar brown) at the Paunglin lake, but no adults, whereas three days later I saw numbers of adults in the Mon river-bed with no young birds.

Nesting.—One nest found was a scrape at the foot of a thistle, and contained a few dead leaves as well as two eggs. A week later there were still only two eggs, with the bird sitting.

Charadrius dominicus. The Golden Plover.

Status.—Only seen three times in the area, at the edge of the Paunglin lake in October and November, and on *kaing* land in January. On 12 October at least one bird of a flock was still in partial breeding plumage, with the white lines down the side of the neck.

Hoplopterus duvaucelli. The Spur-winged Plover.

Habits.—Found mostly in river-beds, also at lake-sides.

Nesting.—A pair seen on 27 February 1937 in the bed of the Irrawaddy were evidently breeding. One bird was on guard, calling, while the other was seen close by, creeping silently away. Newly hatched young were seen on 26 March and 8 April, while a pair seen on 5 June 1935 in the bed of the Irrawaddy evidently, from their behaviour, still had fledglings. The protective colouring of young birds was wonderfully effective on sand-banks.

Status.—Common, or fairly so, throughout the year.

Lobivanellus indicus. The Red-wattled Lapwing.

Habits.—Found mostly at lakes, but also along canals, in paddy-fields, *kaing,* scrub and *indaing.*

Nesting.—Young bird seen on 30 June 1935, with parents still in attendance.

Status.—Common from September to April, and fairly so from May to August.

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[1] Stamping?—EDS.

Microsarcops cinereus. The Grey-headed Lapwing.

Habits.—Found only at lake-sides.

Status.—Earliest date 12 October. Seen occasionally upto February, but never later.

Himantopus himantopus. The Black-winged Stilt.

Habits.—Seen mostly in lakes, also in paddyfields.

Status.—Observed in all months except May and July, and sometimes fairly common, but their numbers were very variable from month to month—apparently they wander locally.

Tringa ochropus. The Green Sandpiper.

Identification.—The fact that the bill and tarsus are about the same length was a good field distinction from the Wood Sandpiper.

Habits.—Seen mostly in river-beds, but also in canals and paddyfields, and at pools in *indaing* jungle. Not infrequently in company with Common Sandpipers, when the larger size was noticeable. It sometimes puts its head right under water when feeding, which I never saw the Common Sandpiper do.

Status.—Never common in the area, and, except for one observation on 19 July 1935, not seen from May to August.

Tringa stagnatilis. The Marsh Sandpiper.

Habits and *Status.*—Only seen twice, on 14 October 1935 at the Paunglin *in*, and on 23 February 1936 at the Dalauk *In.* On the first occasion several birds were joined by a Greenshank, and the similarity was very striking, the Sandpipers appearing exact miniatures of the larger bird. The two birds seen on 23 February were putting their heads under water to feed. They were quicker in their movements than a Wood Sandpiper.

Actitis hypoleucos. The Common Sandpiper.

Habits.—Seen at lakes, river-sides, along canals, and once in a paddyfield.

Status.—Fairly common August and September, common October to April. Earliest date August 5, latest May 6.

Tringa glareola. The Wood Sandpiper.

Habits.—Seen usually on shores of lakes and rivers, but also in young paddy. In the latter, I have seen flocks of many hundreds in August, with the birds very wild.

Status.—Common to very common from August to April. Earliest 14 August, latest 19 April.

Tringa totanus. The Redshank.

Status.—Very uncommon. Only one good observation, on 22 August 1936, when a solitary bird was seen at the water's edge of the Dalauk *In.*

Tringa erythropus. The Dusky Redshank.

Status.—Flocks of Redshanks with no white in the wing, but with conspicuous short white supercilium, were seen on 14 April 1935, 23

February and 20 March 1936, which were presumably this species. On 14 April 1935 about 100 birds were feeding in a pond alongside the Salin canal, with Little Egrets and Stilts. Some were standing in water up to their thighs, others swimming about in parties, with their heads under the surface most of the time. Their legs were a very dull red. On 23 February 1936 a large flock was seen at the Dalauk *In*, again wading in water up to their breasts, and putting their heads right under. The flock seen on 20 March 1936 was feeding in the same way in a small *in* near the head of the Salin canal, which was crowded with waders. On 15 November 1936 a single bird was seen at Paunglin, again with no white visible on either the closed or open wing.

Tringa nebularia. The Greenshank.

Habits.—Seen at river and lake sides and in canals. Once in February I saw a flock of 12 in the Irrawaddy bed.

Status.—Earliest September 4, latest April 22. Never common, but seen in every month between those dates.

? Tringa guttifer. Armstrong's Sandpiper.

Status.—A solitary Sandpiper seen feeding in mud at the Paunglin lake on 19 January 1936 may have been this species. It was about the size of a Redshank, the bill was no longer than the tarsus, the upper plumage appeared pale brown, mottled white, the tail white with dark markings, lower plumage white. The bill and eye were dark, and the legs yellow. It uttered a chirping whistle.

? Philomachus pugnax. The Ruff and Reeve.

Status.—A solitary bird seen at the Paunglin lake on 17 November 1935 was apparently a Reeve. It was feeding in mud with a party of Wood Sandpipers among a number of stationary Golden Plovers. It was the shape of the former, but the size of the latter. The bill was straight and not longer than the tarsus. Upper plumage plain lightish brown, lower plumage pale, bill black, legs orange-yellow.

? Calidris minuta or **C. ruficollis.** The Little Stint or The Eastern Little Stint.

Identification.—Distinguished from Long-toed Stint by white on tail, and from Temminck's Stint in non-breeding plumage by conspicuous speckled appearance of upper plumage.

Status.—Only seen on 23 February 1936, when large numbers were feeding with Wood Sandpipers at the Dalauk *In*, Paunglin. It was presumably too early for Temminck's Stint to be in breeding plumage.

Calidris temminckii. Temminck's Stint.

Identification.—Most birds of a flock seen on 20 March 1936 already had the mottled upper plumage of the breeding season. Distinguished from Little Stint by the all-white outer tail feathers.

Habits.—Seen mostly at river-sides, also at lakes. Sometimes with Little Ringed Plovers.

Status.—Seen in all months from October to April, and sometimes common. Earliest date 14 October, latest 14 April.

Calidris testacea. The Curlew-Stint.

Status.—On 14 October 1935 a flock was seen at the Paunglin lake. The slight curvature of the bill was observed, and the pale streaks on the side of the neck, distinguishing them from Wood Sandpipers.

Capella gallinago. The Fantail Snipe and/or **Capella stenura.** The Pintail Snipe.

Status.—One or both of these were uncommon in August or September, common or very common October to February, fairly common in March, and uncommon in April. The earliest date, presumably a Pintail, was 15 August.

Pelecanus philippensis. The Spotted-billed Pelican.

Habits.—Three adults, seen with one young bird on the Wethigan lake in August, flew up and settled on top of a tall tree, leaving the young bird on the water. No party larger than this one was seen in the area.

Status.—Seen only on the Paunglin and Wethigan lakes. Except for one observation on 19 January 1936, all were between 24 June and 12 October. It was said to visit the Wethigan lake only when at its lowest, say May to August.

Phalacrocorax niger. The Little Cormorant.

Habits.—Seen on lakes and canals. On Paunglin lake I once saw a flock of about 80 fishing in a closely-packed bunch.

Status.—Usually common or very common, but between April and September it sometimes became uncommon.

Anhinga melanogaster. The Indian Darter.

Habits.—Seen mostly on lakes, but also on rivers.

Status.—Not seen from July to September. Seen in all other months, but never common.

Platalea leucorodia. The Indian Spoonbill.

Status.—A single bird was seen on 14 April 1935, feeding with a White Ibis among Lesser Egrets in a pool alongside the Salin canal near its head. The 'scything' action was most distinctive, as was the extraordinary 'spoon'.

Threskiornis melanocephalus. The White Ibis.

Habits.—Seen only on pools and lakes. In one case a single bird was feeding with a Spoonbill, swinging its bill in much the same way, though not with such a regular motion. Once in December a single bird was seen among a large flock of Openbills, and the following day 8 to 10 birds with a flock of about 100 Grey Herons and a large number of Openbills.

Status.—Not seen May to September. Earliest date of return 14 October, from when until April it was seen in every month except March, but never more than fairly common.

? Plegadis falcinellus. The Glossy Ibis.

Status.—Only one doubtful observation, on 29 January 1936, when a solitary bird was seen in a flooded borrow-pit along the S. Mon canal. It may possibly have been Davison's Black Ibis.

? Ciconia ciconia[1]**.** The White Stork.

Status.—On 22 June 1936, in a field near the R. Mon, I saw a stork which, it seems fairly certain, was a young bird of this species. In shape, it was similar to an Adjutant, but the bill was smaller and less massive. The head and neck were brown, the back and rump white, lesser and greater coverts pale grey, median coverts brown, flight feathers black. The bill and legs were flesh colour.

Ciconia nigra. The Black Stork.

Status.—Seen three times; on 7 February 1935 a young bird was in a pool in the river-bed at Minbu, on 8 December 1935 an adult was at the Paunglin lake, and on 18 January 1936 a solitary young bird was feeding with 30 adult White-necked Storks in a soft paddyfield alongside the N. Mon canal. The last-named bird was clearly distinguished from the White-necks by its dark brown neck, and white lower plumage.

Dissoura episcopa. The White-necked Stork.

Habits.—Seen in lakes, canals, and paddyfields, in flocks of up to 30.

Status.—Never seen between 24 April and 14 June, and uncommon during the rest of the year.

Xenorhynchus asiaticus. The Black-necked Stork.

Habits.—Seen mostly in lakes, also in river-beds and canals. In January, at the Paunglin lake, I once saw a party of 8 adults.

Status.—Always uncommon, especially in the rains, but seen in every month from December to April.

Leptoptilos dubius. The Adjutant.

Habits.—Usually seen in paddyfields, but sometimes in villages. On 24 April 1936, I saw a party of at least 9 in a swampy field with 6 or more White-necked Storks and a number of Pariah Kites.

Status.—Uncommon from December to May, but common or very common from June to November, except in October when it was never seen.

Ibis leucocephalus. The Painted Stork.

Habits.—Seen mostly in lakes, also in paddyfields and wet borrow-pits.

Status.—Seen occasionally in all months from June to November, but never in other months. It was said to frequent the Paunglin lake only in July and August.

Anastomus oscitans. The Openbill.

Habits.—Seen mainly in lakes, also in paddyfields.

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[1] Or *Anastomus oscitans.* The Open-billed Stork? —Eds.

Status.—Very variable, but commonest in the cold weather and sometimes very common. Observed in all months except May, July and September.

Ardea purpurea. The Purple Heron.

Status.—Only seen four times, all between 7 Deccember and 8 April. In January I found them fairly common in the rushes of Paunglin lake. On 17 December 1936 a bird got up from a patch of floating water-hyacinth in the Wethigan lake, and on 8 April 1935 one got up from the bed of the N. Mon canal.

Ardea cinerea. The Grey Heron.

Habits.—Seen mostly in lakes, also in river-beds and paddyfields.

Status.—Common or very common in every month, except in May when I never saw it.

? Ardea sumatrana or **Ardea imperialis.** The Dusky Grey Heron or The Great White-bellied Heron.

Status.—On 16 June 1936, and again on the following day, I saw a solitary Heron at Mezali weir (Mon canals head) which was clearly one of these species. It was the shape of the Eastern Grey Heron, but considerably bigger. The crown was dark, there was some pale grey on the upper plumage, and the flight feathers, under wing-coverts, and most of the wings were black or very dark. On 16 June, at dusk, I saw it flying down river, and 24 hours later I saw it settle in the shallow water above the weir.

Egretta alba. The Large Egret.

Habits.—Only seen in lakes.

Status.—Its numbers varied irregularly through the year, but it was seen in all months except May and December and was sometimes very common.

Egretta intermedia. The Indian Smaller Egret.

Habits.—Usually seen in lakes and pools, but also in river-beds and, when nesting, in compounds.

Identification.—In the breeding season, distinguished from Large Egret by breast plumes; in non-breeding season, by comparison of size with Little Egrets and Cattle Egrets, with which it was frequently seen, and which it often exceeded only slightly in size. Breast plumes were seen fully developed on 20 March, and back plumes on 14 April. On 12 August 1935 several birds in a nesting colony had quite lost their black bills, but still had well-developed back and breast plumes.

Nesting.—On 12 August 1935 Burmese *kokkobins* in the compound of Kalaba I.B. contained a large nesting colony of this species, Large Egrets, and Little Egrets, with the last-named predominating greatly. On 26 June 1936 birds were on nests, with one or two Cattle Egrets, in a tree in the Civil Lines at Minbu. On 4 July 1936 I saw them on eggs, with Little Egrets, in the compound of Shauktaw I.B., and another colony, still occupied, was seen in a *kokkobin* near Konzaung on 19 August 1936. The eggs seen on 4 July were a paler green than those of the Little Egret.

Status.—Common or very common every month, except September, when it was not seen.

Egretta garzetta. The Little Egret.

Identification.—I saw crest plumes as early as 21 February and breast plumes on 14 April. One bird seen on 5 June had crest and back plumes, but no breast plumes.

Habits.—Seen mostly in lakes, pools, and river-beds, but also in villages and, when nesting, in compounds. I once saw a bird in the bed of the Irrawaddy which was apparently feeling for food in the mud with its foot. On another occasion I saw a single bird in flight in close company with a single Large or Smaller Egret.

Nesting.—See under Smaller Egret.

Status.—Common or very common in every month.

Bubulcus ibis. The Cattle Egret.

Habits.—Seen mostly at lakes and in river-beds, but also in canal-beds and villages.

Status.—Common or very common in every month.

Ardeola grayii. The Indian Pond Heron.

Habits.—Found at lakes, in canal and river-beds, and in paddy-fields.

Status.—Common from February to September, except in May when it was seldom seen. Very common October to January.

Butorides striatus. The Indian Little Green Heron.

Identification.—The bill appeared to me greenish-black in the field, as stated in F.B.I., not orange as in B. of B. The legs appeared to me green, and I never noticed the orange feet.

Status.—Only seen twice in this area, on 18 December 1934 when a bird was feeding along the water's edge of the Salin canal near its head, and on 25 January 1936 when a bird was fishing at the edge of the R. Mon at Mezali.

Nycticorax nycticorax. The Night Heron.

Habits.—Found in villages and at lakes.

Status.—Uncommon from October to April, not seen from May to September, except in June when it was fairly common.

Ixobrychus sinensis. The Yellow Bittern.

Identification.—I found the yellow legs a conspicuous feature, and in the field it appeared smaller than the Chestnut Bittern.

Status.—Seen only three times in the area, at the Paunglin and Wethigan lakes. One bird seen at the latter was perched on reeds.

Ixobrychus cinnamomeus. The Chestnut Bittern.

Habits.—On lakes only.

Status.—Only observed in June, when it was common, and in August when it was occasionally seen.

Dupetor flavicollis. The Black Bittern.

Habits.—On lakes only.

Status.—Common from June to September, not observed from October to May.

Sarkidiornis melanotos. The Comb Duck.

Identification.—Two birds seen on 12 October 1935 had greyish-white necks and small combs, presumably young males. A flock of 11 seen on 18 November 1935 were all without combs.

Habits.—Seen on lakes and rivers.

Status.—Never seen from May to September, and uncommon during the rest of the year.

Nettapus coromandelianus. The Cotton Teal.

Habits.—Seen mostly on lakes, also on rivers and occasionally on canals.

Status.—Uncommon, especially between February and September.

Anser anser. The Grey Lag Goose.

Status.—Never seen even on the Paunglin lake.

Anser indicus. The Bar-headed Goose.

Status.—Seen once, on 6 March 1936 when a flock of 11 was observed in the bed of the Irrawaddy near Semon. Some were standing or swimming in the water, others standing or sitting on shore.

Dendrocygna javanica. Lesser Whistling Teal.

Dendrocygna fulva. Large Whistling Teal.

Status.—Neither species ever seen in the area.

Casarca ferruginea. The Brahminy Duck.

Habits.—Seen mostly on the Paunglin lake, but also on the Irrawaddy. I have seen them in the Paunglin lake in December and January, not only on passage. I saw them still in a flock of about 10 birds as late as 29 November, and in one of 5 birds on 7 February.

Status.—Seen in every month from November to March, but never common. Earliest 15 November, latest 6 March.

Anas poecilorhyncha [haringtoni]. The Burmese Grey Duck.

Habits.—Found on lakes and in paddyfields and river-beds.

Status.—Uncommon in this area, and only seen in April, June, and October to December.

Anas crecca. The Common Teal.

Habits.—Seen only on lakes.

Status.—Fairly common to common from November to February. Earliest date 13 October. Not observed after February.

Anas acuta. The Pintail.

Local Names. As in Shwebo, it was known in this area simply as '*yit*'.

Habits.—Seen mainly on lakes, but once in January I saw a pair feeding in the Salin canal, and in the same month saw a single adult male on the Wethigan lake with a flock of Pochards.

Status.—Fairly common November to January; not seen in other months.

Anas querquedula. The Garganey Teal.

Habits.—Seen mostly on lakes, but also on small ponds. On 20 March 1936 I saw about 100 on a small *in* near the head of the Salin canal, some miles from any other water. Some of them were walking about on the shore.

Status.—Fairly common November to April, not seen in other months.

Aythya nyroca. The White-eyed Pochard.

Status.—Only seen three times. On 17 March 1935 a solitary female was shot by my companion on a small pool near the head of the Salin canal, and on 8 December 1935 two females were shot on the Paunglin lake. The latter had some black on the head and neck, and were presumably the Eastern race. On 21 January 1936 I saw a flock on the open water of the Wethigan lake, with a number of Common Teal. The white under the tail was conspicuous.

Aythya fuligula. The Tufted Duck.

Status.—Only seen once, on 18 November 1935, when a flock of 10 to 12, all females or young males, were observed on the Dalauk *In*.

Podiceps ruficollis. The Little Grebe.

Identification.—A bird seen on 21 January 1936 still had the chestnut head and neck of breeding plumage.

Habits.—Seen mostly on lakes, but also in paddyfields, and occasionally in borrow-pits and river pools.

Status.—Fairly common, but very local.

CERTAIN OBSERVATIONS ON *BROUSSONETIA PAPYRIFERA* VENT. AND *BOSWELLIA SERRATA* ROXB. IN RELATION TO TRAUMATISM.

BY

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(*With a plate*)

The paper industry is becoming increasingly important in India especially in the Central Provinces and Berar, where through the active support and co-operation of the local government, enterprise has been launched to manufacture newsprint paper from *salai* (*Boswellia serrata* Roxb.) mixed in certain proportions with a chemical pulp of bamboo. As paper-mulberry (*Broussonetia papyrifera* Vent.) is a much quicker growing species and at the same time yields a much better quality of newsprint paper[1] than *salai*, it has been opined by paper experts that *salai* as a raw product shall, in the long run, have to be replaced by paper-mulberry.

A survey has, therefore, been started to study the ecological adaptations of paper-mulberry with a view to introduce and to help establishing it as an important dominant or sub-dominant constituent in the facies of our forest vegetation.

It is generally accepted[2] that the two most potent ecological factors determining and ensuring a successful cultivation of paper-mulberry are sufficiency of soil-moisture and a tolerably good fertile soil. No data, however, seem to be available in regard to the cultivation of paper-mulberry in relation to drought.

It has been chiefly to investigate the possibilities of introduction of paper-mulberry in the light of the aforesaid edaphic factors that the survey of the C. P. forests has been undertaken and the life-history of paper-mulberry is being accordingly studied critically.

After a wide rapid survey of the ecological conditions of the existing forests and in view of the well established adaptations of paper-mulberry, I have reached the conclusion that its plantation could be concentrated safely in areas situated in close proximity of perennial rivers and nallas. Such sites will *pari passu* prove suitable from the view point of ensuring optimal facilities for irrigation during emergent and unfavourable periods of drought from December to May.

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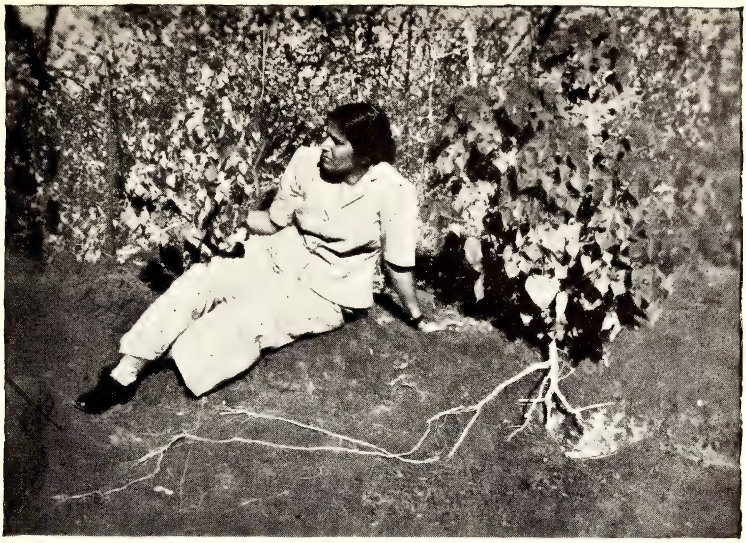
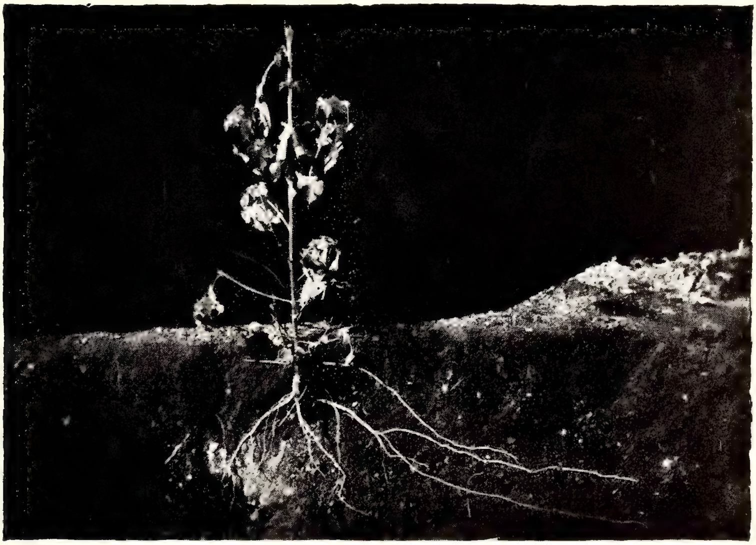
[1] Bhargava, M. P. and Kartar Singh (1945) : Manufacture of newsprint, cheap papers and boards. *Indian Forest Bulletin* No. 108.

[2] Troup, R. S. (1921) : The Silviculture of Indian Trees, Vol. III, Pp. 891–892. (Clarendon Press, Oxford).

Gamble, J. S. (1922) : A Manual of Indian Timbers, p. 683. (Sampson Low, Marston & Co. Ltd., London).



1. A four-month old sapling of *Broussonetia papyrifera* Vent., five of the eight lateral roots of which had been detached from the soil and damaged on 29-12-1947 during the course of root-exposure. This photograph was taken on the 2nd January 1948, 96 hours after the said operation. Note the un-wilted and the turgid condition of the leaves.



2. Another 'four-month old' sapling of *Broussonetia papyrifera* Vent. of which all the roots including the tap-root were damaged and detached from the soil, during the course of the root-exposure on 29-12-1947. This photograph was taken within 2 hours of the operations on the same day. Note the wilted and almost dry condition of all the leaves.

A close study of the roots of paper-mulberry and *salai* saplings (about four months old) was made *in situ* in the nursery to gain an insight into the comparative gearing capacity of their respective root-systems to a particular condition of soil under which the population of saplings had been raised. The observations have brought to light certain interesting ecological adaptations of their roots, which appear to be sharply contrasted from each other.

In *Broussonetia papyrifera* Vent., the tap-root although fairly strong, has not been found to penetrate deep into the murum layers of the soil; the lateral roots, however, formed in abundance are very strongly developed within a few inches of the ground-level and travel superficially all round in a radius of 5–8 feet (Photo No. 1).

In *Boswellia serrata* Roxb., the lateral roots in divergent contrast to that of the paper-mulberry, are very few and weak whereas the tap-root is strongly developed penetrating deeper, even into the murum zones of the sub-soil.

A feature of remarkable ecological importance, however, observed in *Broussonetia papyrifera* Vent. during the course of its root exposure *in situ* calls for some description and critical remarks.

The root-system of the plant under reference and study, was exposed on the 29th December 1947 at about mid-day when it was both sunny and fairly windy and the atmosphere was therefore dry. Inspite of the fact that five lateral roots out of a total of eight had got damaged and hence got detached from the soil during the course of root exposure and that, therefore, as a result it was obviously expected that the transpiration/absorption balance would be most adversely affected causing general wilting of the leaves; yet contrary to expectation it was found to my great amazement that even till 5.30 p.m. in the evening of the same day not a single leaf had drooped and at the same time they were all turgid as if nothing had happened to the plant (Photo No. 1). Whereas in another paper-mulberry plant of the same age (Photo No. 2) where all the lateral roots excluding the tap-root had been damaged and detached from the soil during the course of root exposure, a general wilting of leaves was observable within hardly one hour of the operation. And after an expiry of three hours the leaves in general were rendered so dry and crisp that they could be crushed to powder by rubbing them between the thumb and fore-fingers.

The phenomenon observed appeared to be exciting and therefore, the exposed roots together with the plant was left in the very same position and condition till the 2nd January 1948, during which time observations were continued daily. It is remarkable that even after an expiry of well over 96 hours, there was absolutely no observable wilting in any of the leaves of the experimental plant even of an incipient order.

For the sake of comparison saplings of *Boswellia serrata* Roxb. were similarly treated, and it was found that inspite of their leathery xerophytic leaf even a slight damage to their lateral roots was, curiously enough, sufficient to bring about wilting of their leaves within less than three hours.

The result has been confirmed by repeated observations. It indicates that paper-mulberry possesses enormous potential power to withstand traumatic shocks and of exercising water economy similar to *Jambheri* (*Citrus* sp.) studied by me[1].

SUMMARY

1. In view of the well established ecological adaptations of paper-mulberry, it is recommended that the plantation of this species may safely be concentrated in forest areas in close proximity of perennial rivers and nallas.

2. Saplings (about four months old) of paper-mulberry have a rather shallow tap-root but the laterals are many, widely creeping and strongly developed; whereas those of *salai* (about four months old) have deep seated tap-roots with a very few weak lateral roots.

3. A very remarkable feature of ecological import of paper-mulberry roots is to withstand traumatic shocks and to maintain the optimal transpiration/absorption balance without any wilting of the leaves whatsoever, even when about 60% of its roots are damaged and detached from the soil.

ACKNOWLEDGMENT

I am grateful to Mr. P. N. Nair, Managing Director, National Newsprint and Paper Mill, Ltd., Bombay for offering me facilities during the course of this investigation and to Dr. T. C. N. Singh, D.SC., for the photographs and for his kindly reading through the MS critically.

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[1] Shah, R. (1948) : Comparative studies in traumatism of roots in various species of *Citrus*. (Unpublished work).

OBITUARY

W. P. F. WICKHAM

Percy Wickham, who died at his home near Chagford in Devon, in September 1949 was one of the Wickhams of Winchester. He was educated at Winchester and Cooper's Hill after which he joined the Public Works Department in Burma where he spent all his service, with the exception of 2 years in the Andaman Islands.

He was devoted to the study of birds and was a first class observer. His knowledge of the birds of Burma and of the Andaman Islands was exceeded by few. He was also very keen on small game shooting, especially over a dog and was a good shot. He was good natured, humorous and amusing and I don't believe he had any enemies—I met 'Beetle' Wickham first in the Andaman Isles in 1906 and we spent many happy days together exploring the North Andamans, North Reef Island, Rutland, the Little Andaman, and South Sentinel as well as many other good bird localities. Subsequently we spent a year together in Maymyo where we had many exciting experiences with rare birds. At the request of the Burma Government Wickham wrote the article on the Birds of Burma for the Government Gazetteer.

He also contributed a most excellent article on the Birds of the Upper Burma Hills illustrated by photographs which was published in three parts in the *Journal* of the Bombay Natural History Society in 15 October 1929, 1 March 1930 and 15 July 1930.

On retirement he settled in a village close to Dartmoor in a comfortable cottage, 'Little Mead', in delightful surroundings and with a lovely garden. He will be missed by all who knew him. He leaves a wife to whom we offer our sympathies.

B. B. O.

REVIEWS

1. A NATURALIST IN SARAWAK. By E. Banks. Pp. 125. Kuching, The Kuching Press. (1949).

Mr. Banks was for 20 years the Curator of the Sarawak Museum which in his introduction he calls ' one of the best jobs in the Far East '. This area is well known to all biologists, and to ornithologists in particular, because Wallace has made it famous in history. The nature of the jungle is such that no man in a few years can carry out an exhaustive survey of all its varied fauna, and a lot of work still remains to be done.

There is no doubt that Mr. Banks has seen much, but it is unfortunate that he should have brought it forward in this semi-popular manner. The first chapter deals with several species of edible-nest swifts and contains interesting information about them but as no scientific names are used one is always left guessing which bird is being referred to as Robinson's and which as the brown-rumped, grey-rumped or white-bellied swift. Throughout the book the reader comes across the same difficulty. Large numbers of species are referred to by their popular names only and whole paragraphs consist of running lists of the popular names of birds. It is the same with mammals, and it is unfortunate that this crude method of listing should be used when species from different islands in the Indo-Malayan region could have been listed in tabular form and the text rendered much more intelligible. There is an interesting chapter on the life of turtles, and others containing comparative lists referring to sub-specific difference in the many species which frequent the different areas. But as indicated before, all this is rendered somewhat abstruse and loses value because of the manner of presentation.

There are many interesting field notes, e.g., a record of the mass movements of wild pigs from one fruiting ground to another which assume migratory proportions and which he has witnessed twice in 20 years—' I have seen them travelling purposively through the jungle in convoys up to thirty and forty at a time, silent unswerving, intent on something ; they took little notice of us, and every day for as long as a month party after party would swim the rivers, until at last even the native wearied of pork '.

An interesting zoo-geographic area in Borneo, Java, Sumatra and Malaya is demarcated by what he terms ' Whitehead's ' line drawn in a horizontal plane at an altitude of 3000 feet above sea level. This elevated area holds its own fauna, often with Indian affinities but which is found only on mountain tops 3000 feet or higher. The evident explanation that the present dry land was flooded to a depth of 3000 feet does not conform with the geological data and this is discussed at some length. Attention is drawn to the ' drowned ' river-beds of the South China Sea, which explain the distribution of many fresh-water fish. On the Sumatran rivers 80% of the fish are similar to those in western rivers in Borneo while the similarity between the species in the rivers in east and west Borneo is only 28%.

In spite of the unfortunate manner of its presentation the book contains much interesting information.

H.A.

2. A BIRD PHOTOGRAPHER IN INDIA. By E. H. N. Lowther. Pp. xii+146, plates 78. London, Oxford University Press. (1949). Price Rs. 14.

The names of Bates and Lowther are as well-known to Indian ornithologists as Hosking and Newberry to their counterparts in Britain. In this book, written by the second member of this famous Indian pair, there has been set down the experiences and photographic achievements of a man who has spent forty years in the pursuit of his hobby.

Mr. Lowther was persuaded by Richard Kearton to give up egg-collecting for bird-photography in 1906. The heat of forty Indian summers and the perils of sitting on upturned tables sixty feet up on a tree have done nothing to dim that first enthusiasm lit so many years ago. The author has many wise things to say about the practice of bird photography in India and beginners and advanced workers alike will find much to interest them.

'A Bird Photographer in India' is essentially an autobiography of a bird photographer so that the reader who looks for a discussion of the technical aspects of photography in India will not find it in this book. The serious bird photographer will find this omission a matter for regret because the two British authorities to whom Mr. Lowther refers for information on the techniques of bird photography, despite their fame in Britain, have no experience of the peculiar problems which beset photographers in the tropics and therefore do not discuss them.

Reproduced in this book are some of Mr. Lowther's most famous bird pictures. The picture of the Black-necked Stork alighting on its nest has earned fame by being hung at the International Exhibition of Bird Photography in London in 1935. It has also been reproduced in a number of photographic and other publications. The frontispiece consists of an attractive portrait of a Tree Swift sitting proudly on its single egg.

Anyone who has tried to photograph the birds of marshland and reed-bed will fully appreciate what endurance and persistence have been required to secure some of the pictures of marsh birds which decorate this book, nor need it be pointed out that skill and great courage have gone to the making of the pictures of the birds of prey.

Among this wealth of excellent illustrations there have been included some photographs which this reviewer feels might well have been left out and he would suggest that in any subsequent editions the pictures of the Green Bee-eater, the Spur Fowl and the Mahratta Spotted Woodpecker could with advantage be excluded.

W. T. L.

3. OXFORD JUNIOR ENCYCLOPÆDIA. *Volume II.* (*Natural History*). Pp. 486. 8 coloured plates, numerous photographic plates and sketches. London, Oxford University Press. (1949). Price 30 sh. net.

The Delegates of the Oxford University Press must be congratulated for bringing into fruition their scheme of a Junior Encyclopaedia. The full encyclopaedia is to consist of twelve volumes, each volume dealing with a particular branch of knowledge. The second volume deals with natural history. The editor of the volume is Dr. M. Burton, Deputy Keeper of the British Museum (Natural History). Several people very eminent in their particular sphere, have contributed to this volume : but their approach is not a specialist approach. They have tackled their subject in a manner that is likely to capture the interest of lay people, unfamiliar with the subject.

The main purpose of the Encyclopaedia, is, we are told, to provide a basic book of reference for school libraries, but at no time does an adult reader feel that the book has been 'written down to children'. In a clear, facile manner various topics of natural history are introduced and explained. Heavy, scientific terminology is either avoided or sparingly used. Though the topics are alphabetically arranged very free use is made of the system of cross-indexing which is very useful to those in search of more comprehensive information.

Another attractive feature of the book is the large number of illustrations and coloured plates. There are pictures on practically every page of the book—a feature which is bound to draw readers both young and old to the book.

The range of the Encyclopaedia is fairly comprehensive. I found a great deal of interesting and useful information on practically every topic I looked up, from exotic fish to exotic orchids, from caterpillars to boa constrictors.

The book is priced at 30s, but it will prove a very worthwhile investment for the family, for if children grow up with a book like this constantly at hand, they will learn a great deal about the mystery of life, and will learn to love and respect plant and animal life wherever they find it. I might add that it will not be the children alone that will constantly use this book; it is likely to become a treasured family possession.

R. M. C.

4. FLOWERING TREES AND SHRUBS IN INDIA. By D. V. Cowen. Pp. xvi+ 137. 59 coloured plates and 39 black and white sketches. Bombay, Thacker & Co. Ltd. (1950). Price Rs. 22-8.

In the hot weather when most of the flowering trees put on a profusion of blossoms, and the tired and dusty cities suddenly look flamboyantly colourful because of the masses of gold and red and purple flowers on the trees, many enthusiasts renew their annual efforts to identify the beautiful flowering trees and shrubs of India. Usually these attempts had to be given up in despair because one's friends never made any suggestions worth recording, when one enthused, 'What a beautiful tree! I wonder what it is.' Books on the subject were about as helpful to the average layman. They were either too slight and scrappy or else were musty ponderous tomes that presented such a moth-eaten appearance that one's enthusiasm abated at the very sight of them. If, however, one's amateur enthusiasm were made of sterner stuff, and if one persisted in wading through the tomes, the struggle with jaw-breaking botanical terminology usually left one none the wiser.

People who belong to the category just described, that is, not professional botanists but ordinary lay folk who would like to know the names and something else besides of the beautiful trees that they see around them, will welcome Mrs. Cowen's book as the parched earth welcomes the first showers of rain. Here at last is a book which makes no pretence at being a high-brow botanical study. It is written by a person who says that she sees trees 'with the eyes of a layman'. The book is packed with just the sort of information that the layman wants to obtain. Mrs. Cowen tells us that a certain tree is dedicated to the God Krishna, or that another is sacred to Shiva. She has tried to give us bits from the rich and fanciful web of folk-lore and tradition that generations have woven around Indian trees. Wherever possible, we are given the uses, medicinal and otherwise, to which the tree is put.

But the feature that makes this book of special value to the layman is the number of beautiful coloured illustrations it contains. Mrs. Cowen's consummate skill as an artist is too well known to comment on. Her skill with paints has captured for readers of this book the wealth of colour that adorns the trees of India. The pencil sketches are also very effectively done to give a clear idea of the lines and form and growth of the tree.

The book is also provided with a rough and ready colour key, by means of which trees can be identified with very little trouble.

The section on the flowering shrubs will be of particular interest to gardeners who will rapidly learn to identify all the common garden shrubs that had so far defied identification.

The book is so attractively got up, that in spite of its price of Rs. 22-8, I have still to meet somebody who has been able to resist buying it for himself after having seen it.

R. M. C.

The following books have been added to the Society's Library since April 1950:—

1. FLOWERING TREES & SHRUBS IN INDIA. By D. V. Cowen (Thacker & Co. Ltd., 1950) (A review copy).

2. RACE REALITIES IN CULTURAL GUJARAT. By D. N. Majumdar (Gujarat Research Society, 1950).

3. A CATALOGUE OF THE *HESPERIIDAE* FROM EUROPE, ASIA AND AUSTRALIA IN THE BRITISH MUSEUM (NATURAL HISTORY). By Brig. W. H. Evans [The British Museum (Natural History), 1949].

4. A NATURALIST IN SARAWAK. By E. Banks (The Kuching Press, 1949) (A review copy).

5. INSTRUCTIONS FOR COLLECTORS No. 4 A—INSECTS. By John Smart [The British Museum (Natural History), 1949].

6. OXFORD JUNIOR ENCYCLOPÆDIA, Volume II—Natural History. General Editors—Laura E. Salt & Geoffrey Boumphrey (Oxford University Press, 1949) (A review copy).

MISCELLANEOUS NOTES

1. WILD ELEPHANTS DYING IN ASSAM

Further to my letter of 7th December 1949 on the above subject, more information has now been received. An investigation tour was undertaken by the D.F.O. of the district, accompanied by an Hon. Forest Officer. I give herewith the substance of the latter's report.

During a twelve-day tour a great many wild elephant skeletons were found, and taking these into account as well as the number of tusks and tushes actually produced, it now appears that the number of proved deaths is 74. Taking into consideration the area searched, and the areas left unsearched, as well as the numbers of skeletons found in the different localities, it would seem safe to infer that a similar number of deaths has gone undetected. Therefore the total number of wild elephants which died may be in the neighbourhood of 150.

In addition, the skeletons of 3 bison were found, and it was reported by the Beat Officer that 3 bears (species not mentioned) had also died at the same time. There were reports from villagers, too, that some bison, bear and also sambar had died.

There were reports from villagers in three cases that they actually saw elephants dying, lying prostrate with profuse purging and unable to move. One took a week to die, another less. Flatulence is mentioned, and dung mixed with blood.

I have discussed the foregoing report of the tour of investigation with an experienced veterinary officer, and his opinion is that the disease was probably the intestinal form of anthrax. He was not able to inform me definitely whether elephants are susceptible to rinderpest or not, but from the foregoing symptoms it appears to be anthrax. As far as I know, no examination of the remains of the dead animals has been done by any veterinary officer.

The Conservator of Forests has informed me that catching operations have been stopped in this area, and that steps are being taken to try and prevent further occurrences.

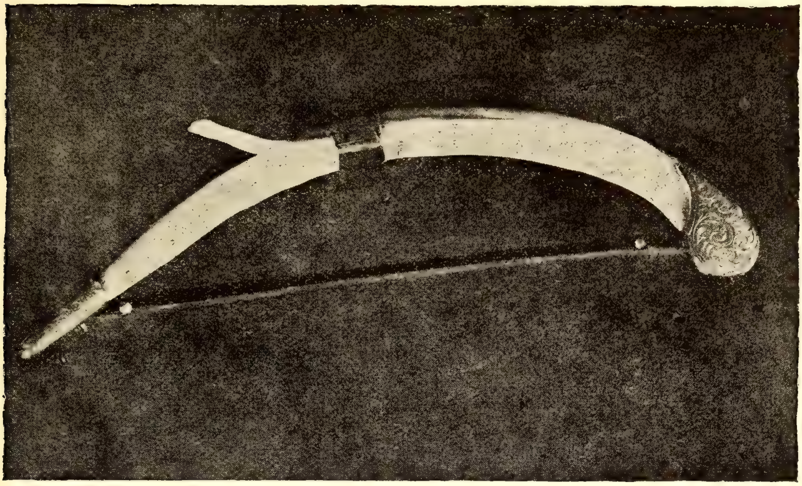
Doyang T.E.,
Oating P.O., Assam,
16*th April*, 1950

E. P. GEE

2. ABNORMAL CLAVICLE BONES IN TIGER

(*With a photo*)

I enclose a photograph of a gold-mounted brooch showing the very extraordinary freak of a normal clavicle bone from one shoulder and a truly diminutive bone from the other shoulder of the same tiger. The large bone measures 4½ in. and the smaller bone 1¾ in. The animal was shot by me in Northern Bengal on the 28th December 1928 and weighed 520 lbs.



Bangalore, W. H. GIBBS
21*st February*, 1950.

3. ON THE YOUNG OF THE CEYLON RUSTY-SPOTTED CAT (*PRIONAILURUS RUBIGINOSUS PHILLIPSI* POCOCK)

On the morning of the 18th February this year, two small kittens of the Ceylon Rusty-spotted Cat were brought to me. They had been found that morning in a small shallow cave or deep alcove beneath a small rock amongst tea bushes, in a field of tea growing close below a rocky patch of virgin jungle, hanging to a steep hill-side (altitude about 3,000 ft.) near Goussa Village in the Badulla District of the Uva Hills.

There were only two young, both ♂ ♂ and still with their eyes closed; they were probably about a week old when found. The mother is stated to have fled and abandoned them, at the time they were discovered.

As the young of this cat does not appear to have been described hitherto, I give below a short description of these two kittens; they are so alike that it is difficult to differentiate between them.

Measurements (taken in the flesh) :		No. 1	No. 2
Head and body	...	138 mm.	138 mm.
Tail	...	65 ,,	62 ,,
Hind foot	...	32 ,,	32 ,,
Ear	...	12 ,,	12 ,,

Colour. General colour above, dark earthy brown with a slight rufescent tinge paling to greyish brown on the sides, the whole spotted with dusky black spots arranged more or less in longitudinal lines. Four interrupted blackish stripes run from the forehead back over the shoulders, two on each side of the central line of the back. Tail dusky brown with very indistinct markings, scarcely amounting to incipient rings; limbs and feet dusky brown, the forearms barred with black; underparts greyish white, with large dusky black spots, arranged in interrupted transverse lines; neck whitish, crossed by two heavy transverse black bars. Head chocolate fawn, rather lighter and more rufescent than the body; nose dusky brown with a narrow white stripe on each side, leading back between two black stripes; a narrow fainter white stripe above each eye and a small, pure white patch beneath each eye; sides of the head light fawn; cheeks white with two narrow dusky stripes; lips white; chin and throat pure white; inner aspect of the ears white, outer black; muzzle brick red.

It is interesting to note that there is no sign, on either of them, of any rusty spotting.

In spite of the greatest care and attention both died after a few days.

Galapitakande Estate,
Namunukula, Ceylon, W. W. A. PHILLIPS
22nd February, 1950.

4. THE FISHING CAT (*PRIONAILURUS VIVERRINUS* BENNETT)

I see in 'The Book of Indian Animals' by Prater, that little is known of the breeding habits of this fine cat.

Yesterday while finishing off the harvesting of a thirty acre plot of sugarcane near my bungalow, I was attracted by the barking of my two Labradors, and on investigation found they had brought to bay on a small tree a fine male specimen, which I shot.

The weight and size were considerably more than those given by Prater, of 25 pounds and 2½ feet. My specimen weighed 32 pounds, and measured between pegs, 3 feet 3 inches, of which the tail was 11 inches.

Later the dogs hunted out a female which escaped, and a kitten of about two months which they killed.

I record the incident because the Fishing Cat is not common in these parts, and to date the birth of this kitten as January or early February.

Koorea,
Bettiah P.O.,
Champaran, A. ST. J. MACDONALD
1st April, 1950.

5. FERAL ALBINO AND PIEBALD RATS

In a recent number of the *Journal* [48(3): 579, 1949] the Rodent Control Officer for Hongkong describes a piebald specimen of *Rattus norvegicus* Berkenhout, taken under feral conditions in a tenement in the Colony of Hongkong. The author says that this is the first one that he had seen out of many thousands of rats that had passed through his hands. It would seem to be of some interest to know if anyone can give any indication of the frequency of occurrence of albinos and piebald specimens among the commensal rats in southern Asia.

The albino and pied rats at present kept in captivity are in all cases domesticated strains of the Norway Rat, and the two forms interbreed freely. It is not known whether the albino variety had a single or multiple origin, but it may safely be assumed that it is derived from one or more feral albino mutants which were captured and kept as pets. At the present time no feral colony of albinos is known. The present domestic stock of albinos is not strictly homozygous, but the character is certainly recessive in crosses between the albino and wild grey forms. The albino reappears in the proportion of one in four in the F_2 generation, and in this and later generations piebald animals may occur. Since the Hongkong specimen seems to have been unique, it is more likely to have been due to a mutation than to the partial emergence of a recessive strain.

References to albino rats in western Europe before the time when the Norway Rat is known to have reached that area show that albino mutants must also have occurred there in *Rattus rattus*; but according to Donaldson (*Memoirs Wistar Inst. Anat. Biol.*, 6: 6, 1924), a careful search by several investigators in the ten years prior to the appearance of his work failed to reveal a living albino specimen. Nor seemingly are there any examples in the leading American museums. On the other hand, Dr. Hossack (*Memoirs Ind. Mus.*, 1: 17–18, 1907) refers to several semi-albino specimens of *Rattus rattus* collected in Calcutta while he was working in the Plague Department of the city.

Rats trapped by the municipal authorities in Singapore are not normally sent to the Raffles museum, and specimens only reach us casually. Nevertheless I have been shown one full albino of *Rattus norvegicus* in the last two years. In addition the Museum reterence collection contains a skin, without precise data, in which the pelage is appreciably paler than Ridgway's light buff (17'f), and a second, taken by a municipal collector on 24th October 1930, which is a uniform light ochraceous buff (Ridgway, 15'd). There seems to be no reason to doubt that the first and third of these examples, and probably the second also, were feral, though I do not see that one can ever be sure that one is not dealing with an escaped specimen in the slums of a large city.

In 1941 I was surveying the fauna of the Cocos-Keeling Islands, in the eastern Indian Ocean. There are about 25 islands round the atoll, the majority of which contain feral forms of *Rattus rattus*, originating presumably from specimens that came ashore from various visiting or wrecked ships in the last century. About 200 examples were taken, of which 65 were sent to Dr. G. H. H. Tate of the American Museum of Natural History, New York, who has reported on them (*Bull. Raff. Mus.*, 22, 1950). The rats on one of the islands are markedly different from the remainder and seem to constitute a hitherto unrecorded race of *Rattus rattus.* The others apparently represent a mixture of the white-bellied *frugivorous* Rafinesque and the dark-bellied *alexandrinus* G. St. Hilaire. One of the 180 examples taken of this latter complex, a small male, was a full albino, with pink eyes. It was caught on an uninhabited island, Pulo Panjang, which apart from it seemed to possess only dark-bellied forms. There can be no question of this specimen having come from a tame or captive stock. Darwin, who visited the atoll in 1836, does not report the presence of rats on this island, which is nearly 5 miles long, but the animals may be descended from the ship rats of the London brig *Sir Francis Nicholas Burton* which was wrecked there ten years earlier. Popularly the rats on this part of the atoll are thought to have come from the American vessel *Robert Portner* which went ashore on one of the other islets in 1878.

RAFFLES MUSEUM,
SINGAPORE,
20th February, 1950.

C. A. GIBSON-HILL

6. THE BURMESE WILD DOG

At page 651 of Vol. 48, No. 4, in his interesting 'Jungle Memories', Lt.-Col. Phythian-Adams asks, 'Is there a separate grey species of wild dog in Burma?' and mentions my statement in the article 'The Indian Wild Dog' (Vol. 41, p. 695) that 'no material is as yet available to establish the identity of the wild dogs of Burma.' That remark as to identity was in connexion with the scientific classification by Pocock of the several races of wild dog throughout India and Burma.

In the Fauna of British India—Mammalia, Vol. II, published on 15th September 1941 (after my article was written and published) Pocock, having seen some new material from Burma, gave the name *Cuon alpinus adustus*, subsp. nov., to the wild dog of Upper Burma, and the name *Cuon alpinus infuscus* Pocock to the race found in Tenasserim and Malaya. It would seem that yet more material is required from the whole of Burma and south to Malaya. The wild dog of Peninsular India is now named *Cuon alpinus dukhunensis* Sykes.

In 'A Game Book for Burma and Adjoining Territories' (1933) E. H. Peacock has a chapter on the Wild Dog (*Cuon* sp.) and says, 'There are said to be two species of wild dog in Burma: *C. dukhunensis* (the Indian wild dog) and *C. rutilans* (the Malay wild dog). I have never seen the former in Burma, but have seen and shot the latter on a number of occasions. The Malay wild dog resembles a large jackal more nearly than it does either dog or wolf. The general coloration is bright red with a black or dark brown tail and smoky-brown or black muzzle. It is smaller and more lightly built than the Indian wild dog and of a brighter red coloration.' He makes no mention of a grey dog, and remarks as to the jackal in Burma 'the colour of the coat varies from yellow or reddish-yellow to blue-grey.'

BANGALORE,
21st February, 1950.

R. W. BURTON,
Lieut-Col. I.A. (Retd.)

7. THE BURMESE WILD DOG AND OTHER MATTERS CANINE

In the *Journal* of December 1949, under Col. Phythian-Adams's 'Jungle Memories' and his interesting accounts of wild dogs, etc., he has left open a query as to the existence of a grey wild dog in Burma.

I spent 10 years in that country previous to the Jap invasion in 1942 and never heard of a grey species of wild dog there (the Burmese name 'tawkhway' merely alluding to wild dogs generally). But, in June 1936, while after bison and saing in the Lower Chindwin District, I saw an animal which, I can only suggest, could have been none other than a grey wild dog.

I was moving camp at the time and, as it was raining—also to protect it from the joltings of the cart—had, unfortunately, rolled up my rifle in my valise and was myself sitting at the back of the cart because of the deep mire on the track. The light was dull and visibility was further obscured by the swirling drizzle.

What I saw on this occasion I, at first, idly regarded as the charred stump of a tree, having a curious resemblance to a large dark-grey dog sitting erect on its haunches and facing the direction from which we had come. At the moment I noticed it, it was about 10 yards away on an open bit of ground beside the track, but must have been half that distance off when the cart came abreast of it. A few moments later, a slight twitch of the head and of a laid-back ear towards the cart moving out of its field of vision revealed it clearly as an animal with a black muzzle and half-shut eyes, having a dark-grey coat—the hair plastered streakily and blackly wet down its flank. Neither of the Burmese in the cart had noticed it, and the wind must have been 'right' for it with respect to the bullocks.

Larger than a jackal (excepting an oversized rabid one I had killed in Mespot) and larger than the average village pariah of Burma, I mentally exclaimed 'Wolf!'—immediately realizing the inaccessibleness of my rifle; while my revolver, in a haversack, was just beyond easy reach and I feared that any movement to get at it would alarm the animal, whatever it was—and I was convinced that it was a wolf. So when, about 30 yards further on, the cart rounded a bend, I secured the revolver and carefully began to stalk back. Unfortunately, however, my Burmese servant elected to get down too and, in spite of my urgent gestures, the driver stopped his bullocks; so that when I came into view of the spot the animal was not there. Recollecting then that I had seen a few thamin deer not far from the track and about 100 yards further along, and supposing that, perhaps, this 'wolf' had been aware of them and was operating with a mate to stalk them, I proceeded in that direction, but the thamin too had disappeared. I should add that there was not a village within miles and, I am sure, no domestic dog would have found reason to be there in that weather and to maintain such immobility during the passing of the cart. On returning from that trip I looked up all available literature but found no reference to the wolf in Burma. Nor, in his 'A Game-Book for Burma' had E. H. Peacock (former Game Warden) mentioned it—both the Indian and Malayan wild dog were stated to exist in Burma, but he admitted that he had never seen the former (a larger and heavier animal than the latter). I eventually came to the conclusion that the 'wolf' I had seen must have been an uncommon species of wild dog peculiar to Burma; as far as I could gather, the Burmese have no name for wolf.

The writer of 'Jungle Memories' concludes his discussion of wild dogs by cautiously citing an instance of 'a variety of wild dog in the Karen Hills . . . black and white, as hairy as a Skye terrier and as large as a medium spaniel'; and, though he seems to invite corroboration, if not zoological discussion of the existence of such a species in the wild state (and, impliedly, restricted to Karenni—the western border of which runs with a part of Burma proper and the northern bulges into the Southern Shan States), or at least leaves the question open, it is with much diffidence that I approach it to say that I have seen a pack of, what I mentally noted at the time as 'piebald' wild dogs. Wild they certainly were, in the sense of feral; but, whether anatomically identifiable with *Cuon*, I haven't the slightest knowledge wherewith to suggest. But, many years ago, I was once invited to a shoot in the Lakhimpur-Kheri District, along both banks of the Sarda River, with two elephants and usually a large gang of beaters—beating through dense and extremely high 'narkal' grass for swamp deer, while hoping to put up tiger or panther. One morning, as my elephant was approaching a large clear space in the grass, pig began to break back—one boar carrying away a strip of cloth off a beater alongside—making my mount nervous and fidgety. So then, seeing another large boar crossing my front towards beaters on the left, I was trying to get a bead on him when I heard my host call out 'Don't shoot—only wild dogs!' and, the next moment, my mahout pointed and said 'Kutha'. Then, on the far side of the clearing, to the left and just outside the shadow of the grass beyond, I saw about a dozen piebald ('black' and 'white'—some with more 'white' than 'black') dogs leisurely getting up and retiring into the grass. Before my elephant reached the open ground, not many strides ahead, the pack had disappeared. But in that brief period I must have noted nearly every one of them—at a distance of under 100 yards—and, though the morning sun was somewhat in my eyes, the whole pack was in bright sunlight to one side when sighted (obviously basking—a cold January morning) and, excepting the indeterminable colour of their dark markings, the dogs were clearly seen; and I retain an impression of a certain similarity in the build of all, probably due to inbreeding—which must, naturally, result in such uniformity, as well as in established habits and thus creating, what may be termed, a 'variety' of the species. A few, smaller than the rest, probably were young dogs. I hesitate to venture a more detailed description, but I seem to remember noting that the last few dogs to disappear bore a general chow-like appearance, or similar to the 'bhootia' dog of the Himalayas (—the Nepal hills lay visible to the north—) and I think these carried bushy tails, high and curled up.

During the noon halt, my host seemed disinclined to discuss these dogs or to explain why he had told me not to shoot at them, merely remarking that they were well known in that neighbourhood—as also were some 'wild cattle'—and that he had seen them on some previous ccasions but that, personally, he 'had no time for them'. Conscious of being only a guest and rather out of my element in that terrain and in that method of hunting, I did not pursue the topic further. It would have been sufficiently interesting to have been able to discover whether these were merely domestic dogs 'gone wild'—or descendants of such—for I have never heard of that occurring in India; and it may be noted that the pigs mentioned must have been basking too, in the same open patch!

As to whether jackals sometimes mate with domestic dogs, I once shot a jackal while in the act. It happened in S. W. Kurdistan and the bitch slowly came about half a mile from the camp to meet the jack which, till then, had been skulking amongst some bushes. I was carrying a ·303 Service rifle and had been waiting for the jackal to show himself, so immediately took the opportunity when he emerged to meet the dog. The incident was preceded by the usual courtship behaviour of dogs. Incidentally, once near the Tigris I was fortunate to be able to shoot a jackal while actually uttering the 'pheal' cry. He was sitting erect at the time in a patch of scrub and did not seem to have noticed my approach on my pony, though the rest of the pack had and was beginning to move away. Though it was dusk the range was only about 30 yards and I was able to shoot him without dismounting. I think that was the only time I ever heard the 'pheal' cry out there; and the cause of it seems obscure, for mounted men—especially Arabs—must have been a common sight to those jackals.

'WALMER',
LOVEDALE,
(NILGIRIS),
5th March, 1950.

K. BOSWELL,
Capt., I.A.M.C. (Retd.)

8. OCCURRENCE OF THE CHESTNUT-BELLIED NUTHATCH (*SITTA CASTANEIVENTRIS CASTANEIVENTRIS*) IN SIND—A CORRECTION

Among papers in the Society's office we found a folder containing 131 typewritten sheets of bird notes which can be traced to the late Mr. T. R. Bell as they are in a peculiar type and correspond with notes on interleaved pages in books bought from Mr. Bells' library. The text also supports this in many ways.

In one part he refers to *Sitta castaneiventris*—the Chestnut-bellied Nuthatch as under:—

> 'I saw a single specimen of this little nuthatch in a babul-grove in Raoti forest in Upper Sind on the 24th of January 1905. I have never seen many of them anywhere in the Presidency even. This one was alone and feeding and was very shy, dodging behind the trunk and branches. But I am sure it was this very species.'

In another place he says:

> 'it might have been *Sitta tephronota* which is said to be common in Baluchistan.'

Dr. C. B. Ticehurst in 'The Birds of Sind', *Ibis* 1922, p. 546, says:

> 'Mr. T. R. Bell records that on 24th January 1905 he obtained a single specimen of *Sitta castaneiventris castaneiventris* in a babul-grove in the Raoti forest in Upper Sind.'

It is apparent that Ticehurst's record refers to the above notes and that no specimen was obtained. The record of *Sitta castaneiventris castaneiventris* from Sind should therefore be deleted or treated as doubtful until further evidence is forthcoming.

c/o Faiz & Co.,
75, Abdul Rehman Street,
Bombay 3, HUMAYUN ABDULALI
15*th May*, 1950.

9. BLACK DRONGOS FOSTERING A KOEL

It may be of interest to record the case of a parasitic cuckoo—Koel (*Eudynamis scolopaceus*)—having as foster parents a pair of Black Drongos or King Crows (*Dicrurus macrocercus*).

When first noticed, the young bird was fairly well grown and able to fly, larger in fact than the foster parents. It was frequently observed perched on a tree branch in the bungalow compound, or on shade trees in the nearby tea. In this position it would sit and complain rather querulously whilst the two drongos chased around frantically to find food. This food, when it did arrive, was not in the least gratefully received, but, after it had been consumed, the young cuckoo would peck and scold at its foster parents sitting alongside until the poor drongos had to fly off again in the apparently never ending quest to satisfy the cuckoo child's voracious appetite.

The trio were observed near the bungalow for about a week early in August, and then disappeared not to be seen again.

What struck me as curious and possibly unusual, was firstly, the choice of foster parents by the hen Koel; secondly that the hen Koel had ever been allowed to approach the nest of the usually brave and pugnacious Black Drongos, who were quite capable of 'seeing off the premises' any Koel; and thirdly, when the young bird had hatched out and had grown actually larger than themselves, the drongos did not recognize it as an alien, but developed into a pair of sorely tried and hard-working slaves.

Perhaps in the end they did recognize an enemy and either killed it off or drove it away.

Teok Tea Estate,
Teok P.O., T. E. H. SMITH
Assam,
5*th March*, 1950.

[In India the Koel gives highest priority as its fosterers to the House and Jungle Crows. Stuart Baker (Cuckoo Problems, p. 197) records eggs from the nest of the Common Myna (*Acridotheres tristis*).

Eggs of the Burmese race of the Koel have been taken from nests of the Chinese Magpie (*Pica p. sericea*) and the Red-billed Blue Magpie (*Urocissa e. magnirostris*) and those of the Chinese race from the nest of the Black-necked Myna (*Gracupica nigricollis*). Both the Black and Ashy Drongos have been recorded as occasional hosts of the Indian Cuckoo (*C. micropterus*), the latter together with the Bronzed Drongo (*Chaptia aenea*) also of the Khasia Hills Cuckoo (*Cuculus canorus bakeri*). —EDS.]

10. ON THE STATUS OF *EURYSTOMUS ORIENTALIS LAETIOR* SHARPE

Widely isolated from the main group of the Broad-billed Roller, *Eurystomus orientalis* (ranging from the lower parts of the Himalaya as far as Korea, the Solomon Islands and the Kimberley District of north-western Australia) there exists in the forests of South India and Ceylon a small population which has been named *Eurystomus laetior* by Sharpe, in 1890 (*Proc. Zool. Soc. London*, p 551, 1890 ; terra typica : forests of Malabar, Nilgiris, and Ceylon, type from Eridge, Travancore, in the British Museum, see Whistler and Ali, *Journ., Bombay Nat. Hist. Soc.* 39, p. 14, 1936). Its distribution suggests it to be a relic of considerable age, and the characters given by Sharpe for this race seem to confirm this view. The colouring of the head is very black, and that of the lower parts intensely blue. Besides two specimens from Ceylon, Sharpe saw one Broad-billed Roller from Eridge (Travancore) and another from the Asamboo (Ashāmbu) Hills (Travancore), see *Catalogue Birds British Museum*, Vol. 17, p. 36, 1892).

However, Sharpe's name has been sunk into the synonymy of *Eurystomus o. orientalis* (described from Java) by all later authors : Stresemann (*Nov. Zool.* 20, p. 299, 1913); Ripley (*Proc. Biol. Soc. Washington* 55, p. 169–179, 1942), Whistler (*Spolia Zeylanica* 23, Nos. 3 and 4, p. 223, 1944), and Peters (*Check-List of the Birds of the World*, Vol. 5, p. 246, 1945) for the apparent reason, that none of them had an opportunity for comparing a series from Ceylon or Travancore, where *Eurystomus orientalis* is a decidedly rare bird. This is especially true for Ceylon ; only a very few (9) specimens having been collected on that island, the last one in 1894. It is as if the bird has to be ranked among the extinct birds of Ceylon.

My attention was drawn to this isolated population by a Ceylonese specimen kept in the Zoological Museum, Berlin, since 1853. It had been collected during the voyage of Prince Waldemar of Prussia (1817–1849) between 13th November and 17th December 1844, together with 15 other species of Ceylonese birds and I was at once struck by the very dark, blackish colour of the cheeks, completely agreeing with Sharpe's diagnostic description. At my request Professor Stresemann, during a stay in London in October 1949, kindly studied the British Museum material. It consists of 5 specimens (including the type), two of them from Travancore (see above) collected 21st December 1871 and 16th August 1877 and three from Ceylon—the two specimens already seen by Sharpe (registered 1853 and 1888 respectively) and one from Maha Oya, E. Greig, December 1894, registered in the British

Museum in 1926. This record remained hidden even to Whistler, owing to war circumstances, but he mentions (1944, l.c.) under No. 3 Legge's sight record of a specimen at Maha Oya. Professor Stresemann stated that the crown and the face of all these birds (except one from Ceylon) are much blacker than in birds from Java and the Philippines. Our single Berlin specimen may at once be distinguished from *E. o. orientalis* by its blackish blue instead ot pure blue ear coverts. This corresponds to the usual intensification of pigments in South India and Ceylonese forest bird sub-species and species.

The Berlin bird from Ceylon measures :—Wing 178 mm., tail 88 mm. wing to tail index 49, i.e., tail measures 49% of wing. In *E. o. orientalis*, Ripley (l.c.) found this index 50–56. The 4 birds of Travancore measured by Whistler (see Ali, l.c.) seem to show nearly the same index. However, if further measurements prove the wing-length of Travancore Rollers to be longer—wings of 4 males 195·5-198 mm., the birds from Ceylon would require a separate, i.e. new name.

For the time being I propose to unite both populations to one sub-species, *E. o. laetior.* This bird is restricted to the evergreen forest biotopes of Travancore and Cochin (see Ali, l.c.). No exact locality or life zone can be given for the specimen of the Berlin Museum. Prince Waldemar travelled from Galle *via* Colombo, Kandy, Badulla, Rathnapura, Adams Peak to Colombo. A week was spent in the north-east of Badulla (near Galbocka) in hunting elephants. (Die Reise . . . des Prinzen Waldemar von Preussen nach Indien . . . 1844–1846. Auszug von I. A. Kutzner, Berlin 1857, pp. 32–115). The other birds collected live in the Lower Dry and/or the Lower Wet and/or Hill Zone. At all events, the new record of the rare bird comes from the southern half of the island—as all records with a definite locality.

To sum up, *E. orientalis laetior* Sharpe (Travancore) is a well defined sub-species, restricted like a number of other birds to south-west India and Ceylon, and separated from the main area of the species by a wide gap. The last record from Ceylon, where it is now possibly extinct, is in 1894. The records of a specimen collected by W. Hoffmeister the naturalist to Prince Waldemar's travels, in the southern half of Ceylon between 13th November and 17th December 1844, and now in Berlin Museum, and another obtained by Greig at Maha Oya, Ceylon, in 1894 are published for the first time.

ZOOLOGISCHES MUSEUM,
BERLIN,
29th March, 1950.

W. MEISE

[In the *Loris* for January 1950, p. 141, it is recorded that a pair was found breeding at Maha Oya in February 1950. They were subsequently shot by the taxidermist of the National Museum, Colombo.

Mr. Sálim Ali who has recently examined the British Museum material measures the wings of 3 unsexed examples from Ceylon as 184–188 mm., whereas a male from Travancore in the same collection has a wing of 200 mm. Two males collected by him in Travancore since the publication of his Travancore Survey Report measured (fresh) Wing 203, 207 ; Tail 99, 106 mm.

Unfortunately the available material does not permit a sex-for-sex comparison between the populations of Ceylon and Travancore, though on the face of it Ceylon birds would appear to be somewhat smaller winged. However, the two populations are quite indistinguishable in colour, and in this regard agree with the type of *laetior*.—Eds.]

11. ON THE BLUE-TAILED BEE-EATER (*MEROPS SUPERCILIOSUS JAVANICUS* HORSF.) IN BOMBAY

In our paper on the 'Birds of Bombay and Salsette', *J.B.N.H.S.* 40, page 169, we recorded this species as a passage migrant around Bombay, but a subsequent re-examination of the two specimens collected in our area disclosed that both of them were in fact immature Blue-cheeked Bee-eaters (*M. s. persicus*). The record was accordingly corrected in the *Journal*—Vol. 45, page 237.

In August 1949 Shamoon Abdulali obtained a male and female at Godhbunder, Salsette Island, which are undoubtedly *javanicus* having blue tails and wings of 128 mm. Subsequent to this I shot another in Thana creek on 9th October 1949 which also had a 128 mm. wing and agreed with them. It appears, therefore, that both forms occur here on passage.

It will be recalled that Littledale obtained *javanicus* nesting along the Mahi River in Gujarat (*J.B.N.H.S.* Vol. 1, page 30).

c/o Faiz & Co.,
75, Abdul Rehman Street,
Bombay,
15*th February*, 1950.

HUMAYUN ABDULALI

12. OCCURRENCE OF THE CINEREOUS VULTURE (*AEGYPIUS MONACHUS* LINNAEUS) AT AHMEDABAD, NORTH GUJARAT

On Sunday, 25th December 1949, I and Syt. R. G. Kharadi, Hon. Secretary of the Gujarat Natural History Society went on a long outing for bird observation. Near Narol village, 5 miles from Ahmedabad (Milestone: 392 miles 5 furlongs) my attention was attracted by a huge black bird apparently resting at the foot of a cactus hedge in a roadside ditch. We immediately got off our bicycles and cautiously approached the bird. As it did not appear to be disturbed by our presence, we got closer, and to our disappointment found that it was already dead. We examined it closely for blood or injury, but found none. The carcass had not stiffened and there was no stench, showing that the bird was not long dead. From its position at the foot of the hedge, which was on a bank at least 4 feet high, it appeared as though the bird in attempting to pass through a gap in the hedge after scrambling up the sloping bank had collapsed through exhaustion. We examined the carcass perfunctorily and concluded that it was a vulture of some sort. As we were in a hurry, however, we did not collect the bird but left it lying where it was. That very night I had to leave for Bombay and hence there was no time to look up references for proper identification. In Bombay, next day, I visited the museum to see if I could get a clue to its identity from amongst the fine reference collection of birds belonging to the Bombay Natural History Society, but was disappointed to find their skins of large birds stored away in boxes and not accessible within the short time at my disposal. I, however, could not get the bird out of my mind and after my return to Ahmedabad, took the earliest opportunity (2nd January 1950) to visit the place again in company with Syt. Kharadi. To our surprise and satisfaction we found the bird still there, though now in a piecemeal condition. We collected the wings and legs which were in perfect condition; also the tail detached from the body minus one feather (which was retrieved on a later visit). The breast bone, though picked clean of all flesh, was still intact and we collected that too. The head and neck were found lying at a distance of about 10 yards in a field on the other side of the hedge, still articulated and in perfect condition except for the eyes. The huge expanse of the wings, the round nostrils, extremely wide gape and tail of 12 feathers left no doubt that the bird was a Cinereous Vulture. The grooved underside of the talons was also noted. Though not given in the Fauna or by Donald (*J.B.N.H.S.*, XXV, XXVI), this character is specifically mentioned by Swann in his excellent 'Monograph of the Birds of Prey'. Our identification was further confirmed by the peculiar head, which was not naked or covered with down as in other vultures but had dense black fur-like feathers on top and around the neck which even at a short distance gave the appearance of a feathered head. The remains were taken to Bombay where my identification of the bird as a Cinereous Vulture was corroborated by the Society.

The Ahmedabad bird measured (in mm.) as follows: Wing 770; tail (of 12 feathers) 390; culmen 94; middle toe without claw 116; middle toe with claw 125; hind toe without claw 37; hind toe with claw 74.

As regards its distribution, the Fauna (2nd Edition) says that 'it occurs in winter in the Punjab, Sind, N.W. Province, United Province and as far south as Ahmedabad, Mhow and Saugar.' Ahmedabad is doubtless mentioned on the strength of the single specimen observed by Capt. A. E. Butler in the winter of 1870. (*Stray Feathers*, III: 441). This was the only authentic record of its previous occurrence in Gujarat, Kathiawar or Kutch. Barnes had never met with the bird in any part of North Gujarat. Littledale does not appear to have seen it in South Gujarat. Neither have Palin, Lester or Sálim Ali recorded it from Kutch. Sálim Ali did not come across the bird in his Gujarat surveys. It thus appears that *Aegypius monachus* has only been recorded twice from North Gujarat where it is no doubt a very rare straggler.

There is one point in connection with this specimen which I would like to mention. When we first examined the bird, we did not find any sign of external injury on its body. Whatever the cause of its death, it was apparently not any physical disability. When we saw it the following week, the chest and back bones had been picked clean of flesh. As all the bones were intact and the ribs still attached to the sternum and vertebra, it may be presumed that the cleaning was done by insects and not by village dogs. The head and neck, of course, were removed to a distance by village dogs but they were not at all mutilated. Is it a fact, as generally believed, that a vulture is not considered fit for consumption by carnivores—even by its own kind which normally stop at nothing?

Gujarat Natural History
Society,
Ahmedabad,
16*th April*, 1950.

HARI NARAYAN G. ACHARYA

13. A BRIEF SUMMARY ON THE CHUKAR PARTRIDGE IN NEVADA, U. S. AMERICA.

The earliest known introduction of the Chukar Partridge (*Alectoris graeca* sp.) into the United States was in 1893 from Karachi, India; however, it was approximately 1935 before the bird was introduced into Nevada, in hopes that it could establish itself as a favourable upland game species.

From the period of 1935 through 1941 the Nevada State Fish and Game Commission had purchased and distributed approximately 775 chukars throughout the State. These plantings have been supplemented to an unknown extent through releases made by private individuals, and by County Sportsmen projects. Unfortunately, no reliable data concerning these latter releases can be obtained. According to the State Fish and Game the number of failures from the initial introductions appeared to be greater than those which resulted in established populations. By 1947, however, the remaining birds from the initial plant had increased in population sufficiently to warrant a short hunting season, and the resistance of the chukar to hunting pressure has enabled us to have seasons in 1948 and 1949 also.

The state of Nevada contains a preponderance of semi-arid land, broken up by innumerable brush-covered mountains, which seem to offer an excellent environment for the chukar. The part of the state in which the species seems to thrive best is at the higher elevations, where the valley floor is usually above 4,000 feet, and the chukar is especially adaptable to rough, mountainous areas where there are rocky hillsides, or steep tallus slopes, in combination with an available water supply. In addition the chukar seems to thrive well on a diet of our native vegetation, and is doing well in a variety of vegetational types.

Since 1947, the State has purchased an additional 100 birds for distribution, and has also been transplanting wild trapped birds to new areas. In addition, the State also purchased 70 pairs of chukar brood stock in February 1950, in an effort to raise birds which may be planted in areas where there has been no establishment. The pen-reared birds are to be released with wild-trapped birds in hopes that this method will reduce mortality, and provide for a higher rate of establishment.

The chukar is fast becoming one of the sportsmen's favourite game birds in Nevada. It is considerably smaller than our native Sage Grouse (*Centrocircus urophasianus*) however, due to the elusive and wary characteristics of the chukar when subject to hunting pressure, and to its excellent table qualities, it is providing the hunter with a great deal of sport.

In conclusion, it can be said that the chukar is now well established, and extending its range in Nevada, and that due to its excellent qualities as a game bird extensive efforts are being made to increase its population.

UNIVERSITY STATION,
RENO, NEVADA, GLEN C. CHRISTENSEN
27th March, 1950.

[In reply to our enquiry Mr. Christensen writes that there is no available data as to the number of Chukar which have been shot. According to his latest estimate he says that less than 3,000 birds have been introduced into the States but since the time of the first introduction around 1935 there has been a considerable increase in the population and a great increase in its range. No census has been taken of the Chukar population but field observations show that they are definitely breeding in the wild.

The *Auk* for July 1950 contains a Report of the American Ornithologists' Union Committee on Bird Protection for 1949 which reads in part—

> ' The drastic widespread decline in pheasant populations, plus success of the Chukar Partridge, *Alectoris*, in establishing itself in Neveda and other western states, has stimulated interest in the introduction of additional exotic game birds. Most biologists, aware of the often disastrous results of successful efforts, question such activities. Efforts are being made to channel all introductions through the Fish and Wildlife Service and secure careful advance information before attempts are made.'

—EDS.]

14. OCCURRENCE OF THE WHITE-WINGED BLACK TERN [*CHLIDONIAS LEUCOPTERUS* (TEMM.)] IN BOMBAY

On 26th March 1950, I was on the Mahim Causeway, Bombay City, with Horace Alexander and Sálim Ali, watching a lot of Little Cormorants, Black- and Brown-headed Gulls, and Gull-billed Terns busily feeding on the edge of the mangrove swamp, with the tide flowing in. Among them we noticed a single Lesser Crested Tern (*T. benghalensis*), and another yet smaller tern, with sharp contrasts of dark and white in its plumage. Though at some distance from us, our binoculars clearly showed the pure white tail (almost square and typical of a marsh tern), sooty-grey upper parts, and black or blackish under-wing coverts. Thus the bird could not have been anything but the White-winged Black Tern (*Chlidonias leucopterus*) which, in spite of the statement in the Fauna, has not been recorded before from anywhere in peninsular India. The only records between the Persian Gulf and Tipperah (Bengal) are from Ceylon, where it is considered a winter visitor (Whistler, Avifauna of Ceylon, p. 268). The Handbook of British Birds says that it winters in

Africa (occasionally south to the Cape), Madagascar, Southern Asia and Malay region, Australia (occasionally in large numbers) and New Zealand (where it is said to have nested).

c/o Faiz & Co.,
75 Abdul Rehman Street, HUMAYUN ABDULALI
Bombay,
28*th March* 1950.

15. KENTISH PLOVERS [*LEUCOPOLIUS ALEXANDRINUS* (LINN.)] AT BOMBAY

On 25th February 1949, I spent an hour watching the wading birds that were spread out over the almost dried-up patch of mud between Colaba and the sea. The great majority of these birds, some hundreds altogether, were Lesser Sand Plovers (*Charadrius mongolus*). With them were birds of several other species, such as Little Ringed Plover (*C. dubius*) and Turnstone (*Arenaria interpres*). I soon noticed some Kentish Plovers (*Leucopolius alexandrinus*), and altogether I am satisfied that there were a score or more of this species scattered about over the ground, mostly keeping rather separate from the sand plovers, which were mainly in one large pack.

At this time of year, most of the Kentish Plovers were in full spring plumage, showing bright fulvous caps and a distinct black patch on the side of the neck. In 'off' plumage, it is not at all easy to distinguish from the sand plover, but it is at all times a rather rounder looking bird, the plumage is paler brown, and the legs are black. Nearly always, too, there is some black on the lores, and the neck patch is larger and darker than in *C. mongolus*. These points, however, can hardly be appreciated except when the two species are in company and can be watched at close range.

Apparently the Kentish Plover has not been recorded in Bombay previously.

24, Rajpur Road,
Delhi, H. G. ALEXANDER
1*st May*, 1950.

16. THE SNOW GOOSE (*ANSER HYPERBOREUS* PALLAS) IN KASHMIR—AN ADDITION TO THE AVIFAUNA OF INDIA

Mr. F. C. D. Ogden has sent us the skin of a goose shot by Mr. George Nedou at Haigham Jheel at Srinagar on 26th February 1950. Mr. Nedou saw this goose flying with nine Grey Lag geese and there were other parties of Grey Lag in the vicinity. The bird is the Snow Goose—*Anser hyperboreus* (probably *hyperboreus* and a male)—a species which has not been recorded before in India. The colour of the eyes was noted as black.

The range of this species according to the Handbook of British Birds is 'N. E. Palaearctic and N. Nearctic regions. Breeds in arctic E. Siberia (Wrangel Islands and Tchutchki peninsula) and in arctic N. America from Pt. Barrow, Alaska to Southampton Is., Baffin Land and islands northward. Replaced by larger race *atlanticus* apparently in N.E. of N. America. Winters in western states of U.S.A., especially California; casual in E. Canada and U.S.A.; also south to Japan on E. coast of Asia; accidental in W. Indies. In Europe reported from Iceland, Norway, Sweden, Germany, ? Holland, France, Greece, ? etc., but probably in many cases merely albinos.'

Mr. George Nedou has very kindly presented this skin to the Society.

114, Apollo Street, Fort,
Bombay, EDITORS.
10*th May* 1950.

17.—GEESE AND DUCK ON THE CHILKA LAKE, ORISSA

Further to correspondence on the above subject published in your issue of April 1949, we have compared notes and think the following brief summary may be of interest to some of your readers.

Geese

When E.C.B. visited the lake at Christmas 1949, the geese in the Nalban area appeared to consist of approximately 2/3rd Grey Lag and 1/3rd Bar-head, but at Satpara where he estimated the number of Bar-head to be about 1,500, he was unable to detect one single Grey Lag among them after a most careful scrutiny on the ground when they were very tame or in the air when they were decidedly the reverse.

From observations made by L.A.C. over the past three years he finds that the Bar-heads are not to be found on Nalban till the middle of December, but by the middle of January are as numerous as the Grey Lag. When he visited the lake on the 10th December 1949 there was not a single Bar-head seen but a week later they were there in small numbers and out of a total of 30 geese bagged, 6 were Bar-head and the remainder Grey Lag. The following bags of geese made in the Nalban area may be of interest.

L.A.C.				E.C.B.		
—	White Front	Grey Lag	Bar-head	—	Grey Lag	Bar-head
31- 1-45 ...	...	...	...	31-1-45 ...	3	1
3- 1-46 ...	...	5	3	31-1-46 ...	10	7
8-12-47 ...	...	14	...	31-1-47 ...	4	3
12-12-48 ...	1	23	1	......	...	...
8- 1-49 ...	...	10	15	X'mas 49 ...	4	6

The immediate conclusion is that the Grey Lag arrive first, the Bar-head come in just before mid-December and by the end of the year numbers tend to even up with a preponderance of Bar-head in January. It would be interesting if other readers confirm this.

Duck

As regards the various species of duck, E.C.B. has not noticed any particular variation in numbers of Pintail. With this L.A.C. does not entirely agree. This season many more Pintail were seen than during the previous two seasons.

The Gadwall is the commonest species and because of their unwary behaviour when on a line of flight, form a high percentage of the bag.

Shovellers are, of course, ubiquitous and Wigeon very numerous, though more wary than the Gadwall.

Common Teal have always been scarce but Garganey are always numerous.

A few Spotbill and Red-crested, Tufted and Common Pochard in varying numbers are usually found. During his two visits to Nalban in December 1949, L.A.C. observed large numbers of Tufted Pochard leaving the island at the first signs of dawn. Unlike the other duck, which were content to remain on the pools on the island if undisturbed, the Tufted Pochard had all left by sunrise.

Lesser Whistling Teal occur but not in the large numbers subsisting in most Orissa jhils such as Balagai near Puri. The Large Whistling Teal which occurs with the Lesser in such places has not been seen by E.C.B. or L.A.C. at Chilka.

E.C.B. has no record of Nukta, Cotton Teal or Mallard on the Chilka Lake, though the two former are very common some 20 miles away at the Balagai jhil, where Tufted Duck (Pochard) and White-eyed Pochard occur in varying numbers during different years. L.A.C. records having shot 3 Cotton Teal on Nalban island on 19-2-27 but does not remember having seen any in recent years.

Brahminy duck are numerous. L.A.C. saw what he estimated at not less than 15,000 in the Naupara area during December 1948. In 1946 E.C.B. saw several small parties of Sheldrake of which one was shot. He has not noticed them in any other year. In January 1948 a party known to L.A.C. shot six and record having seen at least 200. Two were bagged out of a flight of 25–30 birds. In December 1949 L.A.C. saw a flock of 4 Sheldrake and a solitary bird amongst five or six Brahminy.

The earliest L.A.C. records having seen migratory duck on the Chilka is the 19th September 1929 when he bagged 12 Pintail and 10 Garganey during the evening flight on the mainland near Balugaon. The birds were shot as they came into the ripening paddy from the lake.

Chartered Bank Buildings,
Calcutta-1,
1*st February*, 1950.

E. C. BENTHALL
L. A. CRAVEN

18.—GLEANINGS

Mobbing of Crows

There has recently been some correspondence in '*Country Life*' regarding the mobbing of individual rooks by other members of the same species. The Handbook of British Birds mentions this habit and refers to G. K. Yeates's 'The Life of the Rook' in which he expresses the opinion that only mating birds are mobbed. He further comments that this mobbing takes place only when the mating is promiscuous and does not extend to legitimate pairing. The data on which he makes these remarks is very limited but as some kind of mobbing certainly takes place among the crows in India, it would be interesting to observe this more closely and try and account for it here. A somewhat similar process of 'trial by council' and 'mobbing' has been noticed among the mynahs also.

Catching Goshawks

'Kil' in 'Flushing Chukor' (*Onlooker*, January 1950) records keeping awake all night, a goshawk roosting in a tree, by torch and fire, and then catching it by hand the following morning, weary with sleep!

The mating of Partridges

H. B. C. Pollard in 'British and American Gamebirds' (Eyre and Spottiswode, 1945) writes on page 11—'The sexual union of any species of partridge is not generally seen. It is done in the air and is over in a flash. It is a very good test of the credibility or otherwise of anyone who chatters about birds to draw him out gently about this sexual act of partridges. If he says he has seen a cock treading a hen you can write him off as an unreliable witness!'

Stalking the Spanish Ibex

G. Kenneth Whitehead in *Country Life* of 25th February 1949 writes that in 1905 the number of Ibex at Gredos was thought to be 2 males and 5 females. Twelve years after Gredos had been turned into a Royal Reserve the numbers had risen to about 400 and today there are probably about 2000. The Ibex reserve, marked out by 94 posts covers approximately 400 square miles and is supervised by a staff of 16, consisting of a technical inspector who is an expert hunter.

19.—REPLACEMENT OF FANGS IN SNAKES

Might it be possible to arrange for some scientific workers to mark the functional fang of Indian snakes whilst collecting their venom and keep them alive long enough to show whether the ancylosed fang is ever replaced by those found loose in the *vagina dentis*?

It is said that, whilst extracting venom from South African snakes, a fang is sometimes wrenched out of its socket but this must sure be the semi-ancylosed twin fang which not uncommonly occurs alongside the ancylosed fang and is presumed to replace it.

The existence of extra fangs in serial development remains a mystery and the likelihood of any of them revolving to replace the ancylosed fang so as to serve to emit poison through the one and only duct leading to the poison gland lacks experimental proof.

My own experience supports the claim that one can judge of the length of a snake and even help to determine the identity of a species by multiplying the length of one of its teeth. This would be most improbable if it were true that the teeth were constantly shed and replaced.

BRITANNIA BUILDINGS,
WEST STREET,
DURBAN, SOUTH AFRICA,
25*th February*, 1950.

F. GORDON CAWSTON
M.D., F.Z.S.

20.—A BIOMETRICAL STUDY OF *HILSA ILISHA* (HAM.) IN THE GODAVARI RIVER*

During this spawning migration the fish abstains from feeding 1696 and 1943 specimens of male and female *Hilsa* collected from the river below the irrigation anicuts during the spawning season (July to October) of 1947 and 1948 were examined for total length, height and weight of body and for the number of rings found on scales of the pectoral region. The results are presented in tables I and II.

TABLE I

Showing relation between length, height, weight and number of rings of 1696 *male Hilsa*

Length in inches	Height in inches	Weight in oz.	No. of rings	No. of fish examined
11·1—12·0	4	14	1	10
12·1—13·0	4	16	1	10
13·1—14·0	—	—	—	—
14·1—15·0	4	24	2, 4 & 7	107
15·1—16·0	4·5	30	2, 4 & 6	978
16·1—17·0	4·8	39	1, 2, 3 & 4	512
17·1—18·0	5	45	6 & 7	79

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* Communicated with the kind permission of the Director of Fisheries, Madras.

TABLE II

Showing relation between length, height, weight and number of rings of 1943 *female Hilsa*

Length in inches	Height in inches	Weight in oz.	No. of rings	No. of fish examined
15·1—16·0	5·5	32	2	32
16·1—17·0	5·9	46	2	214
17·1—18·0	6·0	58	2, 3 & 4	1114
18·1—19·0	6·1	68	4 & 8	489
19·1—20·0	6·6	78	2, 4 & 8	86
20·1—21·0	—	—	—	—
21·1—22·0	7·0	88	6	8

It will be seen from the tables that the majority of breeders fall under the 15–16 and 17–18 inches length groups. There is a uniform increase in the height and weight of the body, but there is no corresponding increase in the number of rings in the scales. The reason for the latter is briefly discussed below.

It is the contention of various workers on fish scale that for some species growth does not proceed uniformly, but that because of lack of food or because of injuries or other causes, growth takes place more slowly in winter than in summer [2], [3]. Whenever there is less or no feeding, there is arrest in the growth of the fish, and this growth-check is left on the scale in the form of a circular band called ' ring '. In the anadromous *Hilsa*, this period of starvation coincides with the spawning act. During this period there is a general absorption of all the tissues of the body, the scale also being affected by the formation of a ring. A ring on the scale thus denotes a period of spawning; and from the number of rings present on a scale the number of times the fish had spawned may be determined. The youngest male of 11 inches length had one ring in its scales. This fish should have already spawned once, and had now entered the river for the second time. Similarly, the young female of 15 inches, having two rings on its scale, should have spawned twice and had come into the river for the third time. The maximum number of rings that is found is seven in male and eight in female; and it can be inferred that *Hilsa* spawns for the maximum of about eight times during its life. The age of the fish cannot however be definitely stated by a study of the rings unless it is ascertained by future investigations that a mature *Hilsa* breeds every year until its death.

FRESHWATER BIOLOGICAL STATION,
KILPAUK, MADRAS,
January, 1950.

P. I. CHACKO
B. KRISHNAMURTHY

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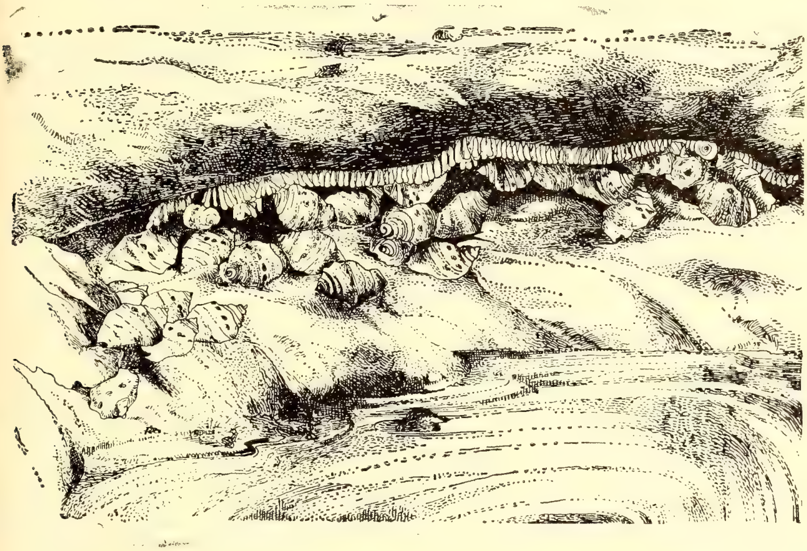
21.—BREEDING HABITS OF *THAIS BUFO* (LAMARCK)

(*With two text figures*)

On the 20th February 1950, at low tide, while collecting marine invertebrate fauna in the Gulf of Manaar off Mandapam Camp (South India) I came across an unusual assemblage of about 300 of the Gastropod mollusc *Thais bufo* (Lamarck). The animals were close pressed against one another at odd angles, together with large patches of yellowish stalked structures—apparently their eggs—lining the inner surface of a hollow rock originally submerged at high tide. The tide was flowing into the hollow, sometimes with rude force, sending the eggs into oscillations. The eggs, however, resisted the tide and remained unaffected.



Assemblage of *Thais bufo* (Lamarck) with its egg-mass, in the hollow of the rock.

I collected a few specimens of the Gastropod and also some egg-clusters. Considerable force had to be used for dislodging the latter.

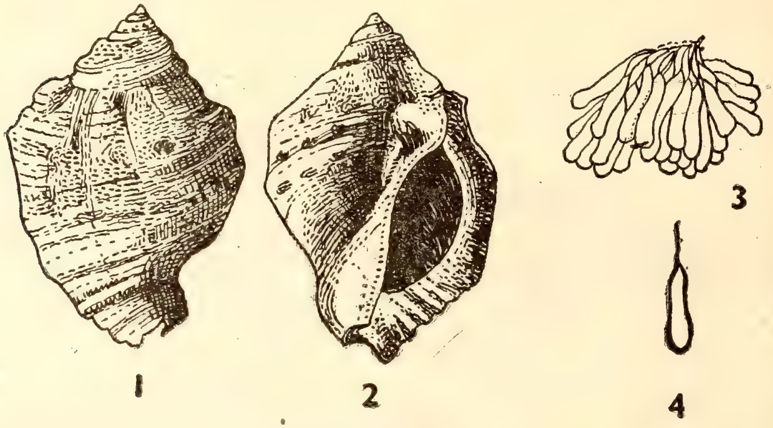
On 3rd March, I revisited the spot at 11 a.m. with a view to making further observations. There was now not a single Gastropod in the hollow, but the entire inner surface of the rock was lined with eggs of an admixture of yellow and violet tints.

At my request Mr. K. Virabhadra Rao, Research Officer (Mollusca), Central Marine Fisheries Research Station, paid a visit to the spot at about 3 p.m., and collected a few of the eggs—both yellow and violet—for examination. At 9 p.m. the same day (3-3-'50) Mr. Rao and I found the tube containing the specimens teeming with microscopic free moving veliger larvæ which were obviously from the violet eggs since these looked a little shrunken while the yellow ones retained their former turgidity.

Important inferences from the above observations may be summarized as follows :—

1. *Thais bufo* (Lamarck) in the breeding season, is found in large pure assemblages.
2. Eggs—each measuring *ca.* 9 mm. × 2 mm. and with a stalk 6 mm. in length—are laid in large numbers and are attached by their stalks to rocks between tide marks in well protected spots. The eggs, when laid, are yellow but turn violet before hatching.
3. It takes 10 to 11 days for the egg to hatch.

Thais bufo (Lamarck) one of the Purpuridae (commonly called the Purples) belonging to the sub-class Streptoneura, inhabits the rocks between the tide marks. It is a carnivorous species feeding upon other molluscs, boring though their shells for soft ' meat '.



1. A single specimen. (natural size)
2. The specimen showing the orifice closed by the dark-coloured operculum.
3. A cluster of eggs.
4. A single egg. (natural size)

The sexes in this species are separate—dioecious. Though sexual dimorphism is not well pronounced the female is slightly bigger than the male.

In Ramnad and Tinnevelly Districts of South India, this species is sometimes eaten by the shore people who call it ' Parattai '. The dull crimson fluid secreted by this form is said to have been used as a dye in olden days.

Bombay Natural History Society,
114 Apollo Street, Fort,
10*th April*, 1950.

V. K. CHARI,
Asst. Curator.

22.—OCCURRENCE OF THE FRESH WATER MEDUSA (*LIMNOCNIDA INDICA*) IN SOUTH-WEST INDIA

The finding of the fresh water medusa, *Limnocnida indica* Annandale, in the pool at the bottom of the Jog falls on the western slope of the Western Ghats appears to be of considerable significance in view of its unusual situation. There are several records [1], [2], [3], [4], [5], [6], of the occurrence of this form in the Krishna drainage on the eastern slope. The Sharavathi river, unlike the others taking their origin from the Western Ghats, empties itself into the Arabian Sea and at Jog there is a sheer drop of about 930 feet. During a holiday at Jog in May 1947, we collected a large number of the medusae of all sizes from the pool at the bottom of the falls on two successive days. For the hydro-electric project the river has been dammed at Hirebhasker, thirteen miles above the falls. It being mid-summer at the time we visited, there was no fall of water. The pool at the bottom is said to be about 175 feet deep and it appeared to be fed by an underground spring. There was a continuous flow and swarms of the medusae were seen floating down. Our collections were all made from water flowing between the huge boulders. Tbe occurrence of tiny ones in large numbers suggested the probability that *Limnocnida indica* should be breeding in the pool.

A search was made for the medusae in the scattered pools at the top of the falls and near the locks about two miles above. Not a single specimen was observed. A search in the reservoir near the Hirebhaskar dam was equally disappointing. The occurrence of *Limnocnida* only in the pool at the bottom of the falls which was rather puzzling at the time of our discovery seems to be a characteristic feature of the distribution of fresh water medusae [6, 7]. In fact, they have been known to disappear completely from their usual habitats during some months of the year [6, 7, 8, 9].

The Indian fresh water medusa shows no asexual reproduction or a fixed hydroid stage and it has been surmised that it should have aresting stage.[4] Rao[6] observed that the eggs get anchored to the substratum by means of minute sticky threads. During the rainy season, when the huge volume of water coming down the falls would make the bottom pool a churning mass, the medusae would be washed away unless they have a resting stage with well developed anchoring devices. Whether they occur in the pool year after year is well worth investigation in view of the interesting speculations [4], [6] regarding the origin, distribution and mode of reproduction of *Limnocnida indica*.

GOVERNMENT COLLEGE, TUMKUR, P. A. RAMAKRISHNA
CENTRAL FISHERIES RESEARCH LABORATORIES, WEST HILL, CALICUT. B. S. BHIMACHAR

CYTOGENETICS LABORATORY, INDIAN INSTITUTE OF SCIENCE, BANGALORE—3. M. K. SUBRAMANIAM

20th April, 1950.

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23.—THE FLOWERING OF *STROBILANTHES*

In a previous note in this *Journal* (44: 605, 1944) I reported a general flowering of *Strobilanthes callosus* Nees that had taken place in Khandala during the summer months of 1943. At present I can add some more details that may be of interest to the members of our Society.

When such a general flowering was seen for the first time, I did not note the exact spots where it had taken place. The following summer there was another more or less general flowering in those parts which had not come into flower the previous year. One thing was noticed at the time, and this was that flowering did not seem to depend on altitude, or exposed situation of the place, or even size or age of the plants. The whole phenomenon may be summarized in the following points: 1. In 1942 a few 'precursors' or 'forerunners' came into flower in various parts of Khandala, a few plants at a time, as Mr. C. McCann told me at the time, 'announcing a general flowering in the near future.' 2. A general flowering took place in most parts of the district in 1943. 3. An almost equal general flowering again took place the following year, 1944, in places where plants had not flowered the previous year. 4. The flowering cycle seemed to close with a few stragglers that bloomed in 1945, a few plants at a time, scattered throughout the district.

To my great surprise and pleasure, in summer 1949 I found in Khandala two clumps in flower, the first below Elphinstone Point, and consisting of only 40—50 plants; the second was on top of Bhoma Hill. Recently I examined the second clump, consisting of many thousands of plants, and found them in fruit.

The top of Bhoma Hill is roughly a triangle with fairly broad or obtuse corners; the edges and slopes of this triangle are covered with almost pure stands of *St. callosus* Nees (*Carvia callosa* Bremek.), the centre of the hill-top is but a grassy plateau. One side of the triangle goes almost perfectly E—W, the second side W to SE, the third side E to SW. Approach to the top of the hill is by a path that passes through Forbay and the 'Saddle' and enters the plateau by the western obtuse corner; the path then continues W to E parallel to the north side of the triangle and descends by the eastern corner, Barometer Hill.

In last year's flowering it was noticed that only the plants in the shaded portion of the diagram had flowered; the dividing lines going W—E and N—S are imaginary, nevertheless they are both astonishingly clear: all the plants west of the NS and south of the WE lines showed masses of fruits, whilst all the neighbouring plants E or N of the line were bare of fruits and had obviously not flowered last season; this is remarkable because even when plants were touching each other across the imaginary line they showed such an independent behaviour. Climatic or edaphic conditions seem to be exactly alike on both sides of the line, yet the clearly different behaviour of plants demands an explanation, which for the present I am unable to give.

Another point of interest is the length of the period intervening between two flowering seasons. The plants that had bloomed in

1949 were certainly in flower in 1943 or 1944; this reduces the flowering period to six or seven years. This coming summer and the following I shall try and keep careful watch for the possible general flowering and the exact spots where it may take place.

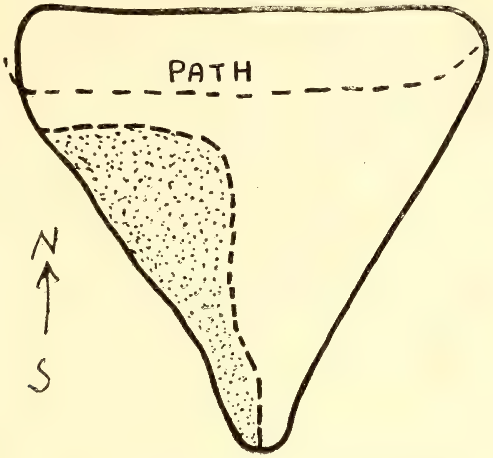

Diagram showing the shape of the top of Bhoma Hill, Khandala.

In 1943 and 1944 I received reliable reports or personally noticed signs of a general flowering at Mt. Abu, Purandhar, Khandala, Matheran, Kanheri Caves, Castle Rock, and as far south as the Nilgiris. May I request readers in various parts of India, where this species is common, to keep a watch over these plants and report any general flowering? It is only through such concerted action that this intriguing problem may finally be solved.

ST. XAVIER'S COLLEGE,
FORT, BOMBAY,
31*st March*, 1950.

H. SANTAPAU
S.J.

24.—*STROBILANTHES CALLOSUS* (NEES) AT JUNAGADH IN SAURASHTRA

Generally *Strobilanthes* species grows in localities having high altitudes. In Saurashtra there are several hills of volcanic origin of trap rock formation, but of all these hills, *Strobilanthes callosus* Nees grows exclusively on the slopes of the valley formed by the sacred hills of the Girnar and Datar ranges. This plant is not seen growing on the top of these hills. This interesting economic plant which occurs at Junagadh is not recorded by Cooke, 1905, but Thakar, 1926, has made a passing remark about it. According to Sutaria, 1949, and Vaidh, 1945, it occurs in Gujarat.

Locally the plant is known as Pandadi. As it occurs on Girnar hill ranges it is cited as Girnari Pandadi by Vaidh, 1945, and Kirtikar *et al*, 1933 and as Junagadhi Pandadi by Thakar, 1926. So its Gujrati name is 'Pandadi' and not 'Karvi' as cited by Sutaria, 1949.

Once upon a time Junagadh was famous for its Pandadi oil and it had attracted experts from Kanoj, who used to come here every year for some time for the extraction of Pandadi oil. This plant has got medicinal value also. Local vaids do not make use of the plant but hakims use it as one of the ingredients in the preparation of an ointment for boils. It is used by the general public for its aromatic and insecticidal properties. But no mention is made about this plant by Chopra *et al*, 1941. It is used to protect woollen fabrics from insects. It may be an insect-repellent rather than an insect-destroyer.

For noting the flowering cycle, a shrub of *Strobilanthes callosus* Nees was brought from the hills and planted in the College garden in the monsoon of the year 1943. This plant flowered for the first time in the month of August, 1949, i.e. after six years. The flowering season lasted upto the month of November. Then the plant entered into fruiting stage and by the end of February 1950 all the leaves disappeared leaving only dried fruits in the axil of the persistent bracts. When young these bracts were green and glabrous; but when they grew old they became brown and were seen densely covered with glandular hairs. Tips of these hairs, were seen bedecked with transparent globules of a viscous substance which sent out strong smell of balsamic nature. Local belief here is that only those bracts which come in contact with dew, produce an odour.

BAHAUDDIN COLLEGE, JUNAGADH — G. A. KAPADIA
20*th March*, 1950.

25.—*MECARDONIA DIANTHERA* (SW.) PENNELL

To the records of this American plant from Surguja State, Benares and Dehra Dun mentioned in Mr. Raizada's article entitled 'Some Interesting Plants from Orissa' in your December 1949 journal, I can add a record from Bihar, having found the plant at Gua in Singhbhum District in February 1950. Sir David Prain in his 'Bengal Plants' published in 1903 records the plant as recently introduced, and in his 'The Vegetation of the districts of Hughli-Howrah and the 24-Pergunnahs', published in 1905, he records it as fairly common about Calcutta. In the Calcutta area I have only found it in a few places near Alipore and there it is much scarcer than it was 10 years ago. Presumably it entered India through the port of Calcutta, but while spreading widely throughout India it now seems to be decreasing in the place where it obtained its first foothold.

19/B, RAJA SANTOSH ROAD,
CALCUTTA, 27, — A. P. BENTHALL
28*th February*, 1950.

26.—A NOTE ON THE OCCURRENCE OF THE ALGA *DRAPARNALDIOPSIS* NEAR KAKINADA, MADRAS PRESIDENCY

Draparnaldiopsis indica Bharadwaja* was discovered at Banaras in August, 1931, and since then it has been collected from almost all parts of India. It has also been reported from America and China. There does not, however, seem to be any previous record of its occurrence in the Madras Presidency. The writer collected this interesting alga from a fresh water tank situated opposite to a temple in Sarpavaram, about three miles away from Kakinada, in the month of October, 1948. It was found growing epiphytically on *Hydrilla* along with *Chaetophora*, another member of the Chaetophorales.

The author expresses his sincere thanks to Dr. Y. Bharadwaja, Principal and Professor of Botany, Jaswant College, Jodhpur, for his kind help in connection with this note.

BIOLOGY DEPARTMENT,
M. R. COLLEGE, B. S. M. DUTT
VIZIANAGARAM,
1*st April*, 1950.

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*Bharadwaja, Y. (1933): New Phytologist, Cambridge, XXXII, 3.

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PART IV—ENTOMOLOGY

Ent—Entomology.

Ent R—Entomology—Reference volume, not lent out.

Ent F R—The Fauna of British India Series (Entomology), Reference volumes, not lent out.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
1	Ent F R	273	8	A	Andrewes, H. E.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON AND BURMA. Coleoptera, Carabidae—Carabinae, Vol. I, 1929.
2	Ent F R	274	8	A	do.	do. Harpalinae, Vol. II, 1935.
3-4	Ent F R	275-276		Mus	do	do. (a duplicate set).
					Ansorge, E. C.	(*See* Lefroy, H. Maxwell & Ansorge, E. C.)
5	Ent	192	9	E	Antram, Chas. B.	BUTTERFLIES OF INDIA, with illustrations of practically every species for easy identification, 1924.
6	Ent F R	251	8	A	Arrow, G. J.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON AND BURMA. Coleoptera Lamellicornia, (Cetoniinae & Dynastinae), 1910.
7	Ent F R	252	8	A	do.	do. (Rutelinae, Desmonycinae & Euchirinae), Part II, 1917.
8	Ent F R	253	8	A	do.	do. (Coprinae) Part III, 1931.
9-11	Ent F R	254-256		Mus	do.	do. (a duplicate set).
12	Ent F R	269	8	A	do.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA. Coleoptera—Clavicornia—Erotylidae—Languriidae and Endomychide, 1925.
13	Ent F R	270		Mus	do.	do.
					Aubertin, Daphne	(*See* White, R. Senior, Aubertin, Daphne & Smart, John.)
14	Ent	88	9	C	Austen, E. E.	BOMBYLIIDAE OF PALESTINE—British Museum (Natural History), 1937.
15	Ent	173	9	D	Austen, Maj. E. E. & Huges, A. W. McKenny	CLOTHES MOTHS AND HOUSE MOTHS—their life history, habits and control—British Museum (Natural History) Economic Series, No. 14, 4th Edition, 1948.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
16	Ent	206	9	E	Austen, Maj. E. E.	THE HOUSE-FLY—Its life history and Practical measures for its suppression—British Museum (Natural History) Economic Series, No. 1 A, 1920.
17	Ent	147	9	D	Avebury, The Rt. Hon. Lord	ANTS, BEES AND WASPS—A Record of observations on the habits of the social Hymenoptera, 16th Edition, Revised, 1902.
18	Ent	200	9	E	Beeson, C. F. C.	FOREST INSECTS, the Ecology & Control of the Forest Insects of India and the neighbouring countries, 1941.
19	Ent	198	9	E	Bell, T. R.	THE COMMON BUTTERFLIES OF THE PLAINS OF INDIA (including those met with in Hill stations of the Bombay Presidency)—A paper published in the *Journal Bombay Natural Histoty Society*—a bound serial, 1909-1913.
20	Ent F R	236	8	A	Bell, T. R. D. & Scott, Lt.-Col. F. B.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON & BURMA—Moths, Family Sphingidae, Vol. V, 1937, (For the first four volumes of this series *see* Hampson, G. F.)
21	Ent F R	236A		Mus	do.	do.
22	Ent	115	9	C	Betten, Cornelius & Mosley, Martin E.	THE FRANCIS WALKER TYPES OF TRICHOPTERA in the British Museum redescribed and figured, 1940.
23	Ent	125	9	D	Bezzi, Mario	THE BOMBYLIIDAE of the Ethiopian Region based on the material in the British Museum (Natural History), 1924.
24	Ent F R	277	8	B	Bingham, Lt.-Col. C. T.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON AND BURMA.—Hymenoptera—Wasps and Bees, Vol. I, 1897.
25	Ent F R	278	8	B	do.	do. Ants and Cuckoowasps—Vol. II, 1903.
26-27	Ent F R	304-305		Mus	do.	do. (a duplicate set).
28	Ent F R	313	8	A	do.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON AND BURMA. Butterflies, Vol. I, 1905.
29	Ent F R	314	8	A	do.	do. Vol. II, 1907.
30	Ent	136	9	D	Bolton, Herbert	INSECTS FROM COAL MEASURES OF COMMENTRY, Fossil Insects, No. 2 British Museum (Natural History), 1925.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
31	Ent	182	9	D	Boyce, Sir Robert W.	Mosquito or Man? The conquest of the tropical world, 1909.
32	Ent	179	9	D	Boyd, Mark M.	An Introduction to Malariology, 1930.
33	Ent	145	9	D	Bruce, Charles T.	Insects & Human welfare—An account of the more important relations of insects to the health of man, to Agriculture and Forestry, Revised Edition, 1947.
34	Ent F R	280	8	B	Brunetti, E.	The Fauna of British India including Ceylon and Burma. Diptera, Brachycera, Vol. I, 1920.
35	Ent F R	281	8	B	do.	do. Diptera—Pipunculidae, Syrphidae, Conopidae, Oestridae, Vol. III, 1923.
36	Ent F R	302		Mus	do.	The Fauna of British India including Ceylon and Burma. Diptera, Brachycera, Vol. I, 1920.
37	Ent F R	303		Mus	do.	do. Diptera—Pipunculidae, Syrphidae, Conopidae, Oestridae, Vol. III, 1923.
38	Ent F R	282	8	B	do.	The Fauna of British India including Ceylon and Burma. Diptera, Nematocera (excluding Chironomidae and Culicidae), 1912.
39	Ent F R	317		Mus	do.	do.
40	Ent F R	297		Mus	do.	do.
41	Ent F R	300	8	A	Burr, Malcolm	The Fauna of British India including Ceylon and Burma. Dermaptera (Earwigs), 1910.
42	Ent F R	301		Mus	do.	do.
43	Ent F R	320	8	B	do.	do.
44	Ent	171	9	D	Butler, Arthur Gardiner	Monograph of Genus Callidry as (from Lepidoptera Exotica, Parts III-XVIII, 1870-1873), 1873.
45	Ent	209	25	E	do.	Illustrations of Typical specimens of Lepidoptera Heterocera in the collection of the British Museum, Part I, 1877.
46	Ent	210	25	E	do.	do. Part II, 1878.
47	Ent	211	25	E	do.	do. Part III, 1879.
48	Ent	213	25	E	do.	do. Part V, 1881. (For Part IV, *see* Walsingham, Lord)
49	Ent	214	25	E	do.	do. Part VI, 1886.
50	Ent	215	25	E	do.	do. Part VII, 1889.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
51	Ent	111	8	A	Butler, Edward A.	A BIOLOGY OF THE BRITISH HEMIPTERA-HETEROPTERA, 1923.
52	Ent F R	241	8	A	Cameron, Malcolm	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON AND BURMA. Coleoptera—Staphylinidae, Vol. I, 1930.
53	Ent F R	242	8	A	do.	do. Vol. II, 1931.
54	Ent F R	243	8	A	do.	do. Vol. III, 1932.
55	Ent F R	244	8	A	do.	do. Vol. IV, Part I, 1939.
56	Ent F R	245	8	A	do.	do. do. Part II, 1939.
57-61	Ent F R	246-250		Mus	do.	do. (a duplicate set).
62	Ent	103	9	C	Cameron, P.	HYMENOPTERA ORIENTALIS or contribution to the knowledge of the Hymenoptera of the Oriental Zoological Region—Papers published in Manchester Memoirs & Journal, Bombay Natural History Society, a bound serial, 1899-1903.
63	Ent	104	9	C	do.	do. Papers published in Manchester Memoirs & the Annals and Magazine of Natural History, a bound serial, 1899-1903.
64	Ent	73	9	C	Carpenter, George H.	A BIOLOGY OF INSECTS, 1928.
65	Ent	152	9	D	Carpenter, G. D. H. & Ford, R. B.	MIMICRY, Methuen's Monographs on Biological subjects, 1933.
					Chalam, B. S.	(*See* Crawford, J.A. & Chalam, B. S.)
66	Ent	85	9	C	Chenu, Dr. Par Le & Lucas, M. H.	PAPILLONS—Encyclopedic, D'Histoire Naturelle ou Traite complet de cette Science.
					Choudhury, K. L.	(*See* Strickland, C., Choudhury, K. L. Ross, Sir Ronald.)
67	Ent F R	283	8	B	Christophers, Col. Sir S. R.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON AND BURMA. Diptera—Fam. Culicidae, Vol. IV, 1933. (For Vols. I & III *see* Brunetti, E.)
68	Ent F R	283A		Mus	do.	do.
69	Ent	122	9	C	Christy, Cuthbert	MOSQUITOES AND MALARIA—A study of our knowledge on the subject at the beginning of the year 1900, with an account of the Natural History of some Mosquitoes, 1900.
70	Ent	90	9	C	Cockerell, T. D. A.	AFRICAN BEES OF THE GENERA CERATINA, HALICTUS AND MEGACHILE. British Museum (Natural History), 1937.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
71	Ent	96	9	C	Cotes, E. C. & Swinhoe, Col. C.	A Catalogue of Moths of India—Sphinges, Pt. I, 1887.
72	Ent	123	9	C	Cotes, E.	Silk—Hand-book of commercial products, Indian Section, No. 23, Imperial Institute Series, 1893.
73	Ent	202	9	E	Crawford, J. A. & Chalam, B. S.	Mosquito-reduction and Malarial Prevention—A precis, 1927.
74	Ent	189	9	D	D'Abreu, E. A.	The Beetles of the Himalayas & how to collect, preserve and study them, 1915.
75	Ent	167	9	D	Distant, W. L.	A Monograph of Oriental Cicadidae, 1889-1892.
76	Ent	224	25	E	do.	Rhopalocera Malayana: a description of the Butterflies of the Malay Peninsula, 1882-1886.
77	Ent F R	285	8	B	do.	The Fauna of British India including Ceylon and Burma. Rhynchota (Heteroptera), Vol. I, 1902.
78	Ent F R	286	8	B	do.	do. Vol. II, 1904.
79	Ent F R	287	8	B	do.	do. (Heteroptera-Homoptera), Vol. III, 1906.
80	Ent F R	288	8	B	do.	do. (Homoptera and Appendix Pt.), Vol. IV, 1908.
81	Ent F R	289	8	B	do.	do. Heteroptera : Appendix, Vol. V, 1910.
82	Ent F R	290	8	B	do.	do. Homoptera : Appendix, Vol. VI, 1916.
83	Ent F R	291	8	B	do.	do. Homoptera : Appendix, Heteroptera : Addenda Vol. VII, 1918.
84-88	Ent F R	292-296		Mus	do.	do. (a duplicate set with the exception of Vols. III & VII.)
89	Ent	119	9	C	Donovan, E.	An Epitome of the Natural History of the Insects of India & the Islands in the Indian seas, 1800.
90	Ent	120	9	C	do.	do.
91	Ent	150	9	D	Duncan, James & Jardine, Sir William	Beetles, British & Foreign, containing full description of the more important varieties.
92	Ent	155	9	D	Duncan, James	Beetles—Entomology—The Naturalist's Library, Vol. II, 1835.
93	Ent	86	9	C	Edwards, F. W., Oldroyd, H. & Smart, J.	British Blood-sucking Flies, 1939.
94	Ent	82	9	C	Edwards, F. W.	Mosquitoes of the Ethiopian region—Culicine adults & Pupae, Part III, 1941. (*See* Hopkins, G. H. E. for Part I, 1936 and Evans, Alwen M. for Part II, 1938.)

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book.
95	Ent	151	9	D	Eltringham, H.	BUTTERFLY LORE, 1923.
96	Ent	81	9	C	Evans, Alwen M.	MOSQUITOES OF THE ETHIOPIAN REGION, Anopheline—adults and early stages, Part II, 1938. (*See* Hopkins, G. H. E. for Part I, 1936)
97	Ent	97	9	C	Evans, Brig. W. H.	A CATALOGUE OF AFRICAN HESPERIIDAE indicating the Classification & Nomenclature adopted in the British Museum, 1937.
98	Ent	208	9	E	Evans, Col. W. H.	THE IDENTIFICATION OF INDIAN BUTTERFLIES, First Edition 1927.
99	Ent	196	9	E	do.	do. 2nd Edition, Revised, 1932.
100	Ent	181	9	D	Fieder, Karl	MONOGRAPH OF THE SOUTH AMERICAN WEEVILS OF THE GENUS CONOTRACHELUS, 1940.
101	Ent	67	9	B	Fletcher, T. Bainbrigge	REPORT OF THE PROCEEDINGS of the second Entomological Meeting held at Pusa on the 5th to 12th February, 1917, 1917.
102	Ent	68	9	B	do.	REPORT OF THE PROCEEDINGS of the third Entomological meeting held at Pusa on the 3rd to 15th February, 1919, Vol. I, 1920.
103	Ent	69	9	B	do.	do. Vol. II, 1920.
104	Ent	70	9	B	do.	do. Vol. III, 1920.
105	Ent	71	9	B	do.	REPORT OF THE PROCEEDINGS of the fourth Entomological meeting held at Pusa on the 7th to 12th February, 1921, 1921.
106	Ent	72	9	B	do.	do. fifth Entomological meeting held at Pusa on the 5th to 10th February, 1923, 1924.
107	Ent	72A	9	B	do.	do.
108	Ent	78	9	C	do.	SOME SOUTH INDIAN INSECTS AND OTHER ANIMALS OF IMPORTANCE considered especially from an economic point of view, 1914.
109	Ent	190	9	E	do.	do.
110	Ent	140	9	D	Flammarion, Ernest	JEAN ROSTAND INSECTES (1936).
					Ford, E. B.	(*See* Carpenter, G. D. H. & Ford, E. B.)
111	Ent	31	9	A	Forel, A. & Grandidier, Alfred	LES FORMICIDES, Histoire Naturelle des Hymenopteres—Histoire, Physique, Naturelle et Politique de Madagascar, Vol. XX, 1891.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book.
112	Ent	117	9	C	Forel, Auguste	Les Formicides, des Indes et de Ceylon——A paper published in *J. B. N. H. S.*, a bound serial Parts I—V, 1892-1895.
113	Ent	137	9	D	do.	Formiciden, aus dem Naturhistorischen Museum in Hamburg—various reprints of papers on Formicidae bound together, 1900-1910.
114	Ent F R	271	8	A	Fowler, W. W.	The Fauna of British India including Ceylon and Burma. Coleoptera--General Introduction and Cicindelidae & Paussidae, 1912.
115	Ent F R	272		Mus	do.	do.
116	Ent F R	307	8	B	Fraser, Lt.-Col., F. C.	The Fauna of British India including Ceylon and Burma. Odonata, Vol. I, 1933.
117	Ent F R	308	8	B	do.	do. Vol. II, 1934.
118	Ent F R	309	8	B	do.	do. Vol. III, 1936.
119-121	Ent F R	310-312		Mus	do.	do. (a duplicate set.)
122	Ent F R	321	8	B	Fraser, Lt.-Col. F.C.	The Fauna of British India including Ceylon and Burma. Odonata, Vol. I, 1933.
123	Ent	174	9	D	Gahan, Charles J. & Laing, Frederick	Furniture Beetles, their life history and how to check or prevent the damage caused by the worms—British Museum (Natural History), Economic series No. II, 4th Edition, 1946.
124	Ent F R	267	8	A	Gahan, C. J.	The Fauna of British India including Ceylon and Burma. Coleoptera, (Cerambycidae), Vol. I, 1906.
125	Ent F R	268		Mus	do.	do.
126	Ent	89	9	C	Ghosh, C. C.	Insect Pests of Burma, 1940.
127	Ent	180	9	D	Giglioli, George	Malarial Nephritis, Epidemiological & Clinical notes on Malaria, Blackwater fever, Albuminuria and Nephritis in the interior of British Guiana based on seven years continual observation, 1930.
128	Ent	91	9	C	Giles, Lt.-Col. Geog. M.	A Hand-Book of Gnats or Mosquitoes giving the anatomy and life-history of the Culicidae together with descriptions of all species noticed up to the present date. Second Edition, rewritten and enlarged, 1902.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
129	Ent	221	25	E	Government of India	A COLLECTION OF PAPERS ON BEE-KEEPING in India, 1883.
130	Ent	223	25	E	do.	PROCEEDINGS OF THE IMPERIAL MALARIAL CONFERENCE held at Simla in October 1909, 1910.
					Grandidier, Alfred	(*See* Forel, A & Grandidier, Alfred.)
131	Ent	83	9	C	Green, E. Ernest	THE COCCIDAE OF CEYLON. Parts I-III, 1922.
132	Ent	84	9	C	do.	Do. do. Parts IV-V, 1922.
					Grote, Arthur	(*See* Hewitson, William C., Moore, Frederic & Grote, Arthur.)
133	Ent	216	25	E	Hampson, George Francis	ILLUSTRATIONS OF TYPICAL SPECIMENS OF LEPIDOPTERA HETEROCERA in the collection of the British Museum—The Lepidoptera Heterocera of the Nilgiri District—Part VIII, 1891. (For Parts I-III & V-VII *see* Butler, Arthur Gardiner; for Part IV, *see* Walsingham, Lord).
134	Ent	217	25	E	do.	do. The Macrolepidoptera Heterocera of Ceylon. Part IX, 1893.
135	Ent F R	232	8	A	do.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON AND BURMA—Moths—FAMILIES: (1) Saturniidae, (2) Brahmaeidae, (3) Bombycidae, (4) Eupterotidae (5) Sphingidae (6) Notodontidae (7) Cymatophridae (8) Sesiidae (9) Tinaegeriidae (10) Syntomidae (11) Zygaenidae (12) Psychidae (13) Cossidae (14) Arbelidae (15) Hepialidae (16) Callidalidae (17) Drepanulidae (18) Thyrididae (19) Limacodidae (20) Lasiocampidae (21) Pterothysanidae (22) Lymantriidae (23) Hypsidae, Vol. I, 1892.
136	Ent F R	233	8	A	do.	do. Families—(24) Arctiidae (25) Agaristidae (26) Noctuidae, Vol. II, 1894.
137	Ent F R	234	8	A	do.	do. Families—(26) Noctuidae (Contd.) (27) Epicopidae, (28) Uraniidae (29) Epiplemidae (30) Geometridae, Vol. III, 1895.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book.
138	Ent F R	235	8	A	Hampson, Sir George F.	The Fauna of British India including Ceylon and Burma. Moths—Families—(31) Pyralidae, Vol. IV, 1896.
139-142	Ent F R	237-240		Mus	do.	do. (a duplicate set)
143	Ent F R	316		Mus	do.	do. Vol. I, 1892.
144	Ent	48	9	B	do.	Catalogue of the Lepidoptera, Phalaenae—Syntomidae—in the collection of the British Museum, Vol. I, 1898.
145	Ent	49	9	B	do.	do. Amatidae and Arctiadae (Nolinae & Lithosianae) Supplement to Vol. I, 1914.
146	Ent	50	9	B	do.	do. Arctiadae (Nolinae & Lithosianae), Vol. II, 1900.
147	Ent	51	9	B	do.	do. Lithosiadae (Arctianae) & Phalaenoididae, supplement to Vol. II, 1920.
148	Ent	52	9	B	do.	do. Arctiadae (Arctianae) & Agaristidae, Vol. III, 1901.
149	Ent	53	9	B	do.	do. Noctuidae, Vol. IV, 1903.
150	Ent	54	9	B	do.	do. do. Vol. V, 1906.
151	Ent	55	9	B	do.	do. do. Vol. VI, 1906.
152	Ent	56	9	B	do.	do. do. Vol. VII, 1908.
153	Ent	57	9	B	do.	do. do. Vol. VIII, 1909.
154	Ent	58	9	B	do.	do. do. Vol. IX. 1910.
155	Ent	59	9	B	do.	do. do. Vol. X. 1910.
156	Ent	60	9	B	do.	do. do. Vol. XI. 1912.
157	Ent	61	9	B	do.	do. do. Vol. XII, 1913.
158	Ent	62	9	B	do.	do. do. Vol. XIII, 1914.
159	Ent	63	9	B	do.	do. Plates Vols. I-III & Supplements Vols. I & II, 1898-1901.
160	Ent	64	9	B	do.	do. Plates—Vols. IV-X, 1903-1911.
161	Ent	65	9	B	do.	do. Plates—Vols. XI-XIII, 1912.
162	Ent	66	9	B	do.	Description of new Genera & Species of Lepidoptera Phalaenae of the Subfamily Noctuinae (Noctuidae) in the British Museum (Natural History), 1926.
					Hammond, A. R.	(*See* Miall, L. C. & Hammond, A. R.)
					Henry, G. M. R.	(*See* Woodhouse, L. G. O. & Henry, G. M. R.)
163	Ent	153	9	D	Hewitt, C. G.	House-flies and How they spread Disease—The Cambridge Manuals of Science and Literature, 1912.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
164	Ent	168	9	D	Hewitson, William C., Moore, Frederic & Grote, Arthur	DESCRIPTION OF NEW INDIAN LEPIDOPTEROUS INSECTS from the collection of the late Mr. W. S. Atkinson, M. A., F. L. S., Rhopalocera & Heterocera (Sphingidae-Hepialidae), 1879.
165	Ent	184	9	D	Hehir, Maj.-Gen. Sir Patrick	MALARIA IN INDIA—Oxford Medical Publications, 1927.
166	Ent	187	9	D	Hemming, Francis	THE GENERIC NAMES OF THE HOLARCTIC BUTTERFLIES, Vol. I, 1758-1863, 1934.
167	Ent	322	9	E	Hinton, H. E.	A MONOGRAPH OF THE BEETLES associated with stored products, British Museum (Natural History), Vol. I, 1945.
168	Ent	131	9	D	Hoffmann, Dr. E. & Kirby, W. Egmont	THE YOUNG BEETLE-COLLECTOR'S HANDBOOK. 1902.
169	Ent	35	9	B	do.	do.
170	Ent	130	9	D	Hope, Rev. F. W.	THE COLEOPTERIST'S MANUAL containing the Lamellicorn Insects of Linnaeus & Fabricius, 1837.
171	Ent	80	9	C	Hopkins, G. H. E.	MOSQUITOES of the Ethiopian Region. Larval Bionomics of mosquitoes & Taxonomy of Culicine larvae, Part I, 1936.
					Howlett, F. M.	(*See* Lefroy, H. Maxwell & Howlett, F. M.)
172	Ent	34	9	B	Horsfield, Thomas & Moore, Frederic	A CATALOGUE of the Lepidopterous Insects in the Museum of the Hon. East-India Company—Papiliones, Sphinges & Bombyces, Vol. I & II, 1857-1859.
					Hughes, A. W. McKenny	(*See* Austen, Maj. E. E. & Hughes, A W. McKenny.)
					Huxley, Julian	(*See* Portmann, Prof. Adolf & Huxley, Julian)
173	Ent	94	9	C	Imms, A. D.	A GENERAL TEXT-BOOK OF ENTOMOLOGY including the Anatomy, Physiology, Development & Classification of Insects, 2nd Edition, 1930.
174	Ent	195	9	E	do.	do. 5th Edition, 1942.
175	Ent	138	9	D	do.	INSECT NATURAL HISTORY-The New Naturalist—A survey of British Natural History, 1947.
176	Ent F R	265	8	A	Jacoby, Martin	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON AND BURMA. Coleoptera, Chrysomelidae, Vol. I, 1908.
177	Ent F R	266		Mus	do.	do.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
178	Ent	139	9	D	Jameson, A. Pringle	REPORT on the Diseases of Silkworms in India, 1922.
					Jardine, Sir William	(*See* Duncan, James & Jardine, Sir William)
					Johannsen, Oskar, A.	(*See* Riley, William, A & Johannsen, Oskar A.)
					Johnson, C. G.	(*See* McKenny—Huges, A. W. & Johnson, C. G.)
					Jordan, Dr. Karl	(*See* Smart, John, Jordan, Dr. Karl & Whittick, R. J.)
					Jordan, Dr. K.	(*See* Rothschild, The Hon. Walter & Jordan, Dr. K.)
					Kirby, W. Egmont	(*See* Hoffman, Dr. E. & Kirby, W. Egmont)
179	Ent	36	9	B	Kirby, W. F.	A SYNONYMIC CATALOGUE of Orthoptera. Orthoptera Euplexoptera, Cursoria et Gressoria — (Forficulidae, Hemimeridae, Blattidae, Mantidae, Phasmidae), Vol. I, 1904.
180	Ent	37	9	B	do.	do. Orthoptera, Saltatoria, Part I (Achetidae et Phasgonuridae), Vol. II, 1906.
181	Ent	38	9	B	do.	do. Orthoptera, Saltatoria, Part II (Locustidae vel Acrididae), Vol. III, 1910.
182	Ent	100	9	C	do.	A SYNONYMIC CATALOGUE of Diurnal Lepidoptera, 1871.
183	Ent	106	9	C	do.	ELEMENTARY TEXT-BOOK OF ENTOMOLOGY, 1885.
184	Ent F R	298	8	A	do.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON AND BURMA. Orthoptera (Acrididae), 1914.
185	Ent F R	299		Mus	do.	do.
186	Ent F R	318	8	B	do.	do.
187	Ent F R	319	8	B	do.	do.
188	Ent	183	9	D	Knowles, Maj. Roberts & Senior-White, Ronald	MALARIA, its investigation and control with special reference to Indian conditions, 1927.
189	Ent	207	9	E	do.	do.
					Laing, Frederick	(*See* Gahan, Charles J. & Laing, Frederic)
190	Ent	176	9	D	do.	THE COCKROACH, its life history and how to deal with it, British Museum (Natural History) Economic Series, No. 12, 4th Edition, 1948.
191	Ent	218	25	E	Lefroy, H. Maxwell & Ansorge, E. C.	REPORT on an Inquiry into Silk Industry of India, Lefroy—the silk industry—Vol. I, 1907.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
192	Ent	219	25	E	Lefroy, H. Maxell & Ansorge, E. C.	Report on an Inquiry into Silk Industry of India, Ansorge, Present condition of the silk trade of India, Vol. II, 1917.
193	Ent	220	25	E	Lefroy, H. Maxwell	do. Lefroy, Appendices to Vol. I, Vol. III, 1917.
194	Ent	194	9	E	do.	Indian Insect Pests, 1906.
195	Ent	197	9	E	Lefroy, H. Maxwell & Howlett, F. M.	Indian Insect Life. A Manual of the Insects of the plains (Tropical India), 1909.
196	Ent	199	9	E	Lefroy, H. Maxwell	Manual of Entomology with special reference to Economic Entomology, 1923.
197	Ent	112	9	C	Le Prince, Joseph A. & Orenstein, A.J.,	Mosquito control in Panama. The Eradication of Malaria and Yellow fever in Cuba and Panama, 1916.
198	Ent	102	9	C	Lubbock, Sir John (Lord Avebury), Myers, J. G.	Ants, Bees and Wasps. A Record of observations on the habits of the social Hymenoptera, 1929.
					Lucas, M. H.	(*See* Chenu, Dr. Le & Lucas, M. H.)
199	Ent	141	9	D	Mani, S.	Serphoidea, Catalogue of Indian Insects, Part 26, 1941.
200	Ent	222	25	E	Marjoribanks, Major J. L.	Report on certain features of Malaria in the island of Salsette, 1913.
201	Ent	142	9	D	Marshall, J. F.	The British Mosquitoes, 1938.
202	Ent FR	257	8	A	Marshall, Guy A. K.	The Fauna of British India including Ceylon and Burma. Coleoptera, Rhynchophora: — Curculionidae, 1916.
203	Ent FR	258		Mus	do.	do.
204	Ent	45	9	B	Marshall, Major G. F. L. & Niceville, Lionel de	The Butterflies of India, Burma & Ceylon—A descriptive handbook of all the known species of rhopalocerous Lepidoptera inhabiting that region, with notices of allied species occurring in the neighbouring countries along the border with numerous illustrations, Vol. I, 1882.
205	Ent	46	9	B	do.	do. Vol. II, 1886.
206	Ent	47	9	B	do.	do. Vol. III, 1890.
207	Ent F R	259	8	A	Maulik, S.	The Fauna of British India including Ceylon and Burma. Coleoptera, Chrysomelidae (Hispinae & Cassidinae), 1919.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
208	Ent F R	260	8	A	Maulik, S.	The Fauna of British India, including Ceylon and Burmah. Chrysomelinae and Halticinae), 1926.
209	Ent F R	261	8	A	do.	do. (Galerucinae), 1936.
210-212	Ent F R	262-264			Mus do.	do. (a duplicate set).
213	Ent	144	9	D	McKenny Huges, A. W. & Johnson, C. G.	The Bed-bug, its habits and life history and how to deal with it, British Museum (Natural History) Economic Series, No. 5, 1942.
214	Ent	132	9	D	Meyrick, Edward	Exotic Microlepidoptera. Vol. I, 1912.
215	Ent	133	9	D	do.	do. Vol. II, 1916.
216	Ent	134	9	D	do.	do. Vol. III, 1923.
217	Ent	135	9	D	do.	do. Vol. IV, 1930.
218	Ent	154	9	D	Miall, Prof. L. C.	The Natural History of Aquatic Insects. Short nature-studies, 1903.
219	Ent	186	9	D	Miall, L. C. & Hammond, A. R.	The Structure & Life-history of the Harlequin Fly (*Chironomus*), 1900.
					Mirza, Dr. M. B.	(*See* Quadri, M.A. & Mirza, Dr. M. B.)
220	Ent	157	9	D	Moore, F.	Lepidoptera Indica : Rhopalocera, Fam. Nymphalidae Subfam. Euploeinae & Satyrinae, Vol. I, 1890-1892.
221	Ent	158	9	D	do.	do. Subfam. Satyrinae (contd.) Elymniinae, Amathusiinae, Nymphalinae (Group Charaxina), Vol. II, 1893-1896.
222	Ent	159	9	D	do.	do. Subfam. Nymphaline (contd.) Groups Potamina, Euthaliina, Limentina, Vol. III, 1896-1899.
223	Ent	160	9	D	do.	do. Subfam. Nymphalinae (contd.) Groups Limenitina, Nymphalina and Argynnia, Vol. IV, 1899-1900.
224	Ent	161	9	D	do.	do. Subfam. Nymphaline (contd.) Groups, Melitaeina and Eurytelina, Subfam. Acraeinae, Pseudergolinae, Calinginae & Libytheinae, Fam. Riodinidae, Subfam. Nemeobiinae, Fam. Papilionidae, Subfam. Nemeobiinae, Thaidinae, Leptocircinae & Papilioninae, Vol. V, 1901-1903.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
225	Ent	162	9	D	Moore, F.	LEPIDOPTERA INDICA: RHOPALOCERA, Fam. Papilionidae Subfam. Papilioninae (contd.) Fam. Pieridae, Subfam. Pierinae, Vol. VI, 1903-1905.
					Moore, Frederic	(*See* Horsfield, Thomas & Moore, Frederic).
					do	(*See* Hewitson, William C. Moore, Frederic & Grote, Arthur)
226	Ent F R	279	8	B	Morley, Claude	THE FAUNA OF BRITISH INDIA, INCLUDING CEYLON AND BURMA. Hymenoptera, Ichneumonidae—*Ichneumones deltoidei*—Vol. III, Part I, 1913.
227	Ent F R	306		Mus	do.	do. (For the first two volumes *see* Bingham, Lt.-Col. C. T.)
228	Ent	143	9	D	Mosely, Martin	A REVISION OF THE GENUS, *Leptonema* (Trichoptera), British Museum (Natural History), 1933.
					do.	(*See* Betten, Cornelius & Mosely Martin E.)
229	Ent	124	9	C	Myers, J. G.	INSECT SINGERS, A Natural History of the Cicadas,
230	Ent	204	9	E	do.	do.
					do.	(*See* Lubbock, Sir John and Myers, J. G.)
231	Ent	188	9	D	Needham, James G. Frost, Stuart W. Tothill, Beatrice H.	LEAF—MINING INSECTS, 1928.
					Niceville, Lionel de	(*See* Marshall Maj. G. F. L. Niceville, Lionel de)
					Oldroyd, H.	(*See* Edwards, F. W., Oldroyd, H. & Smart, J.)
232	Ent	172	9	D	Ordnance Laboratories, Cawnpore.	THE BATTLE OF THE BUGS, Some notes for Military units in India on the prevention of the damage to equipment by insects and other animals—Pest control pamphlet No. 4, 1945.
					Orenstein, A. J.	(*See* Le Prince, Joseph A. & Orenstein, A. J.).
233	Ent	105	9	C	Packard, Alpheus S.	A TEXT-BOOK OF ENTOMOLOGY including Anatomy, Physiology, Embryology & Metamorphoses of Insects for use in Agricultural & Technical Schools & Colleges as well as by working Entomologists, 1898.
234	Ent	170	9	D	Portmann, Prof. Adolf & Huxley, Julian	THE BEAUTY OF BUTTERFLIES—12 colour plates from nature, Iris Book, 1945.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
235	Ent	177	9	D	Quadri, M. A. H. & Mirza, Dr. M. B.	EXTERNAL & INTERNAL ANATOMY OF THE BUFFALO-LOUSE —*Haematopinus tuberculatus* Burmeister—ON INDIAN INSECT TYPES, Aligarh Muslim University Publications (Zoological Series) 1, 1948.
236	Ent	79	9	C	Ramakrishna Iyyer, T. V.	HANDBOOK OF ECONOMIC ENTOMOLOGY FOR SOUTH INDIA, 1940.
237	Ent	74	9	C	Riley, William A. & Johannsen, Oskar A.	MEDICAL ENTOMOLOGY—A Survey of insects and allied forms which affects the health of man and animals, 2nd Edition, 1938.
238	Ent	205	9	E	Ross, H. H.	HOW TO COLLECT & PRESERVE INSECTS, Illinois State Natural History Survey, circular 39 (Third printing with additions), 1949.
239	Ent	113	9	C	Rothschild, The Hon. Walter	A REVISION OF THE PAPILIOS OF THE EASTERN HEMISPHERE, exclusive of Africa from *Novitates Zoologicae* Vol. II, August, 1895.
240	Ent	114	9	C	Rothschild, The Hon. Walter & Jordan, Dr. K.	A MONOGRAPH OF CHARAXES & THE ALLIED PRINOPTEROUS GENERA from *Novitates Zoologicae* Vol. V, Dec. 1898.
241	Ent	32	9	A	Saussure, M. Henri de	MELANGES ORTHOPTEROLOGIQUES—Mémoires de la Société de Physique et D'Histoire Naturelle, de Genevê, Tome, XXV—Seconde Partie, Fascicule, VI, 1877-1878.
242	Ent	33	9	A	do.	MANTIDES—Mélanges Orthoptérologiques — Bulletin de la Société Suisse D'Entomologie, Tome III, 1869.
243	Ent	169	9	D	do.	PRODROME DES OEDIPODIENS INSECTS DE L'ORDRE DES ORTHOPTERES, Memoires de la Société de Physique et D'Histoire Naturelle de Genêva, Tome, XXX, No. 1, 1888.
					Scott, Lt.-Col. F. B.	(*See* Bell, T. R. D. & Scott, Lt.-Col. F. B.)
					Senior-White, Ronald	(*See* Knowles, Maj. Robert & Senior-White, Ronald.)

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244	Ent	225	25	E	Seitz, Dr. Adalbert	THE MACROLEPIDOPTERA OF THE WORLD. A systematic description of the known Macrolepidoptera of the Palearctic Region: The Palearctic Butterflies—Diurnals, Text, Secn. I, Vol. I, Tome, I, 1909.
245	Ent	226	25	E	do.	do. Plates.
246	Ent	227	25	E	do.	do. The Palearctic Bombyces and Sphinges, Text, Division I, Vol. II, 1913.
247	Ent	228	25	E	do.	do., Plates.
248	Ent	229	25	E	do.	THE RHOPALOCERA OF THE INDO-AUSTRALIAN FAUNAL REGION, Vol. IX, 1908.
249	Ent	230	25	E	do.	do. Plates.
250	Ent	231	25	E	do.	do. Bombyces & Sphinges of the Indo-Australian Region, Phalaenae or Moths, (Translated into English by Prout, L. B.) Text & plates, Section II, Vol. X, 1908.
251	Ent	201	9	E	Shipley, A. E.	THE MINOR HORRORS OF WAR, 1915.
252	Ent	87	9	C	Smart, John, Jordan, Dr. Karl & Whittick, R. J.	A HANDBOOK FOR THE IDENTIFICATION OF INSECTS OF MEDICAL IMPORTANCE, 1943.
253	Ent	175	9	D	Smart, John	LICE, British Museum (Natural History) Economic Series, No. 2A, 2nd. Edition, 1948.
					Smart, John	(*See* White, R. Senior, Aubertin, Daphne & Smart, John)
					do.	(*See* Edwards, F.W., Oldroyd, H. & Smart, J.)
254	Ent	126	9	D	Snyder, Thomas Elliott.	OUR ENEMY THE TERMITE 1935.
255	Ent	92	9	C	Stebbing, E. P.	DEPARTMENTAL NOTES ON INSECTS THAT AFFECT FORESTRY, 1902.
256	Ent	93	9	C	do.	INDIAN FOREST INSECTS OF Economic importance—Coleoptera, 1914.
257	Ent	148	9	D	do.	INSECTS INTRUDERS IN INDIAN HOMES.
258	Ent	149	9	D	do.	do.
259	Ent	191	9	E	do.	INDIAN FOREST INSECTS of Economic Importance. Coleoptera, 1914.
260	Ent	193	9	E	do.	A MANUAL OF ELEMENTARY FOREST ZOOLOGY FOR INDIA, 1908.

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261	Ent	178	9	D	Strickland, C. & Choudhury, K. L.	AN ILLUSTRATED KEY TO THE IDENTIFICATION OF THE ANOPHELINE LARVÆ OF INDIA, CEYLON & MALAYA WEST OF WALLACE'S LINE with practical notes on their collection, (with supplement 1931), 1927.
					Swinhoe, Col. C.	(*See* Cotes, E. C. & Swinhoe, Col. C).
262	Ent	98	9	C	do.	CATALOGUE of Eastern & Australian Lepidoptera Heterocera in the collection of the Oxford University Museum—Sphinges & Bombyces, Part, I, 1892.
263	Ent	99	9	C	Swinhoe, Col. C, Walsingham, Rt. Hon. Lord & Durrant, John Hartley	do., Noctuina, Geometrina & Pyralidina, Pterophoridae & Teneina, Pt. II, 1900.
264	Ent	163	9	D	Swinhoe, Col. C.	LEPIDOPTERA INDICA : RHOPALOCERA—Fam. Papilionidae, Subfam. Pierinae (contd.), Fam. Lycaenidae, Subfam. Gerydinae, Lycaenopsinae & Everinae, Vol. VII, 1905-1910. (For vols. I-VI *see* Moore, F.).
265	Ent	164	9	D	do.	do., Fam. Lycaenidae, Subfam. Lycaeninae, Plebeinae, Lampidinae, Chrysophaninae, Poritiinae, Amblypodiinae, Curetinae, Liphyrinae, Ruralinae, Vol. VIII, 1910-1911.
266	Ent	165	9	D	do.	do., Fam. Lycaenidae (contd.) Subfam. Horaginae, Deudorixinae, Hypolycaeninae, Zesiusinae, Asphnaeinae, Biduandinae, Cheritrinae, Loxurinae, Fam. Hesperiidae, Subfam. Ismeneinae, Achalarinae, Vol. IX, 1911-1912.
267	Ent	166	9	D	do.	do., Fam. Hesperiidae, (contd.) Subfam. Celaenorrhinae, Hesperiinae, Pamphilinae, Astictopterinae, Suastinae, Erionotinae, Matapinae, Notocryptinae, Plastingiinae, Erynninae, followed by an addenda of new Genera & Species, a synopsis of families and subfamilies and an index of Genera & Species for the complete work, Vol. X, 1912-1913.

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268	Ent F R	315		Mus	Talbot, G.	THE FAUNA OF BRITISH INDIA INCLUDING CEYLON AND BURMA. Butterflies, Vol. I, 1939.
269	Ent	39	9	B	Theobald, Fred. V.	A MONOGRAPH OF THE CULICIDAE OR MOSQUITOES—Mainly compiled from the collection received at the British Museum from various parts of the world in connection with the investigation into the cause of Malaria conducted by the colonial office and the Royal Society, Vol. I, 1901.
270	Ent	39	9	B	do.	do. Vol. II, 1901.
271	Ent	40	9	B	do.	do. Vol. III, 1903.
272	Ent	41	9	B	do.	do. Vol. IV, 1907.
273	Ent	42	9	B	do.	do. Vol. V, 1910.
274	Ent	43	9	B	do.	do. Plates, 1901.
275	Ent	110	9	C	Tillyard, R. J.	THE BIOLOGY OF DRAGONFLIES (Odonata or Paraneuroptera) Cambridge Zoological Series, 1930.
276	Ent	95	9	C	Uvarov, B. P	LOCUSTS AND GRASS HOPPERS—A handbook for their study and control, 1928.
277	Ent	212	25	E	Walsingham, Lord	ILLUSTRATIONS OF TYPICAL SPECIMENS OF LEPIDOPTERA HETEROCERA in the collection of the British Museum, North-American Tortricidae, Part, IV, 1879, (For parts I-III & V-VII *see* Butler, Arthur Gardiner).
278	Ent	127	9	D	Wardle, Thomas	INDIAN SILK CULTURE, being a paper on the silks in the Indian Silk Culture Court at the Colonial and Indian Exhibition, read in the conference room on the 24th June, 1886 & Descriptive catalogue. Royal Commission & Government of India Silk Culture Court, 1886.
279	Ent	185	9	D	do.	HANDBOOK OF THE COLLECTION ILLUSTRATIVE OF WILD SILKS OF INDIA, in the Indian section of the South Kensington Museum, with a catalogue of the collection and numerous illustrations, 1881.
280	Ent	118	9	C	Warren, B. C. S.	MONOGRAPH OF GENUS *Erebia*. British Museum (Natural History), 1936.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
281	Ent	75	9	C	Waterhouse, G. A.	WHAT BUTTERFLY IS THAT? A Guide to the Butterflies of Australia, 1932.
282	Ent	203	9	E	Waterstone, James	FLEAS AS A MENACE TO MAN AND DOMESTIC ANIMALS, their life-history, habits and control. British Museum (Natural History) Economic Series No. 13, 1916.
283	Ent	121	9	C	Watson, E. Y.	HESPERIIDAE INDICAE, being a reprint of Descriptions of the Hesperiidae of India, Burma and Ceylon, 1891.
284	Ent	128	9	D	Weed, Clarence M.	BUTTERFLIES, The Nature Library, 1926.
285	Ent	107	9	C	Westwood, J. O.	AN INTRODUCTION TO THE MODERN CLASSIFICATION OF INSECTS founded on natural habits & corresponding organization of the different families, Vol. I, 1839.
286	Ent	108	9	C	do.	do. Vol. II, 1840.
287	Ent	129	9	D	do.	THE BUTTERFLIES OF GREAT BRITAIN with their transformation delineated & described, 1855.
288	Ent	101	9	C	Wheeler, William Morton	THE SOCIAL INSECTS: Their Origin & Evolution, 1928.
289	Ent F R	284	8	B	White, R. Senior—, Aubertin, Daphne & Smart, John	THE FAUNA OF BRITISH INDIA INCLUDING THE REMAINDER OF THE ORIENTAL REGION. Diptera—Fam. Calliphoridae Vol. VI, 1940. (For Vols. I & III *see* Brunetti, E. & for Vol. V *see* Christopher, Lt.-Col., Sir S. R.)
290	Ent F R	284A		Mus	do.	do.
291	Ent F R	284B	8	B	do.	do.
					Whittick, R. J.	(*See* Smart, John, Jordan, Dr. Karl & Whittick, R. J.)
292	Ent	109	9	C	Williams, C. B.	THE MIGRATION OF BUTTERFLIES. Biological Monographs & Manuals, No. IX, 1930.
293	Ent	146	9	D	Wood, Rev. J. G.	INSECTS ABROAD, being a popular account of foreign insects, their structure, habits and transformations, 1877.
294	Ent	6 15	9	D	Woodhouse, L. G. O. & Henry, G. M. R.	THE BUTTERFLY FAUNA OF CEYLON. *Ceylon Journal of Science*, 1942.

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295	Ent	116	9	C	Wroughton, Robert Charles	OUR ANTS. A Paper read before the Bombay Natural History Society, Parts I & II, 1891 & 1892.
296	Ent R	1	9	A	Wytsman, P. (General Editor)	GENERA INSECTORUM, FASCICULES I-XI :— 1. Fam. Gyrinidae (Coleoptera), Regimbart, M. 2. ,, Evaniidae (Hymenoptera), Kieffer, J. J. 3. ,, Lathridiidae (Coleoptera), Belon, Le R. P. 4. ,, Leptocircinae Lepidoptera), Wytsman, P. 5. ,, Libytheidae (Lepidoptera), Pagenstecher, A. 6. ,, Ornithopteridae (Lepidoptera, Rippon, R. 7. ,, Geotrupidae (Coleoptera), Boucomont, A. 8. ,, Hylophylidae (Coleoptera), Pic, M. 9. ,, Cynipidae i (Hymenoptera), Torre, W. Dalla & Kieffer, J. J. 10. ,, Cynipidae ii (Hymenoptera), Torre, W. Dalla & Kieffer, J. J. 11. ,, Mutillidae (Hymenoptera), Andre, E. Volume I, 1902-1903.
297	Ent R	2	9	A	do.	do. FASCICULES XII-XIV. 12. Coleoptera, Fam. Buprestidae, Kerremans, Ch. 13. Coleoptera, Fam. Burdae, Schenkling, S. 14. Coleoptera, Fam. Sagridae, Jacoby, M. Volume II, 1903.
298	Ent R	3	9	A	do.	do. FASCICULES, XV-XIX. 15. Orthoptera Fam. Eumastacidae, Burr, M. 16. Lepidoptera Fam. Edicopiidae, Janet, A. & Wytsman, p. 17. Lepidoptera Fam. Hesperidae, Mabille, P.

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						18. Hymenoptera Fam. Ichneumonidae, Subfam. Ichneumoniae, Berthoumieu, V. 19. Hymenoptera, Fam. Vespidae, Torre, K. W. von Dalla,
299	Ent R	4	9	A	Wytsman, P.	Volume, III, 1904. do. FASCICULES XX-XXIV. 20. Lepidoptera. Fam. Nymphalidae, Subfam. Brassolinae, Stichel, H. 21. Coleoptera, Fam. Donacidae, Jacoby, M. & Clavareau, H. 22. Hymenoptera, Fam. Braconidae, Szepligeti, Gy. V. 23. Coleoptera, Fam. Crioceridae, Jacoby, M. & Clavareau, H. 24. Heteroptera, Fam. Pentatomidae, Subfam. Scutellerinae, Schouteden, H.
300	Ent R	5	9	A	do.	Volume IV, 1904. FASCICULES XXV-XXXI. 25. Isoptera Fam. Termitidae, Desneux, J. 26. Diptera Fam. Culicidae, Theobald, F. V. 27. Hymenoptera, Fam. Lydidae, Konow, F. W. 28. Hymenoptera, Fam. Siricidae, Konow, F. W. 29. Hymenoptera, Fam. Tenthredinidae, Konow, F. W. 30. Heteroptera, Fam. Pentatomidae, Subfam. Graphosomatinae, Schouteden, H. 31. Lepidoptera, Fam. Nymphalidae, Subfam. Discophorinae, Stichel, H.
301	Ent R	6	9	A	do.	Volume, V. 1904-1905. do. FASCICULES XXXII-XXXIX. 32. Coleoptera, Fam. Megascelidae, Jacoby, M. & Clavareau, H. 33. Coleoptera, Fam. Megalopidae, Jacoby, M. & Clavareau, H. 34. Hymenoptera, Fam. Ichneumonidae, Subfam. Pharsaliinae, Porizontinae, Szepligeti, G. V.

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						35. Coleoptera, Fam. Paussidae, Desneux, J. 36. Lepidoptera, Fam. Nymphalidae, Subfam. Amathusiinae, Stichel, H. 37. Lepidoptera, Fam. Nymphalidae, Subfam. Heliconiinae, Stichel, H. 38. Coleoptera, Fam. Carabidae, Subfam. Anthiinae, Rousseau, E. 39. Lepidoptera, Fam. Nymphalidae, Subfam. Hyanthinae, Stichel, H.
302	Ent R	7	9	A	Wytsman, P.	Volume VI, 1905-1906. do. FASCICULES XL-XLVII. 40. Coleoptera, Fam. Carabidae, Subfam. Mormolycinae, Rousseau, E. 41. Coleoptera, Fam. Platypsillidae, Desneux, J. 42. Diptera, Fam. Chironomidae, Kieffer, J. J. 43. Diptera, Fam. Muscaridae, Subfam. Oestrinae, Bau, A. 44. Diptera, Fam. Phoridae, Brues, Ch. T. 45. Collembola, Fam. Neelidae, Börner, C. 46. Coleoptera, Fam. Elateridae, Schwarz, O.
303	Ent R	8	9	A	do.	Volume VII, 1906. do. FASCICULES, XLVII-LIV. 47. Heteroptera, Fam. Pentatomidae, Subfam. Aphylinae, Schouteden, H. 48. Orthoptera, Fam. Acridiidae, Subfam. Tetriginae, Hancock, J. L. 49. Coleoptera, Fam. Chrysomelidae, Subfam. Clytrinae, Jacoby, M. & Clavareau, H. 50. Coleoptera, Fam. Plastoceridae, Schwarz, O. 51. Coleoptera, Fam. Dicronychidae, Schwarz, O. 52. Heteroptera, Fam. Pentatomidae, Subfam. Asopinae (Amyoteinae), Schouteden, H. 53. Coleoptera, Fam. Lampyridae, Oliver, E.

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						54. Hymenoptera, Fam. Dryinidae, Kieffer, J. J.
304	Ent R	9	9	A	Wytsman, P.	Volume VIII, 1906-1907. do. FASCICULES, LV-LX. 55. Orthoptera, Fam. Blattidae, Subfam. Ectobinae, Shelford, R. 56. Diptera, Fam. Blepharoceridae, Kellogg, V. 57. Lepidoptera, Fam. Sphingidae, Rothschild, W. de. & Jordan, K. 58. Lepidoptera, Fam. Papilionidae, Subfam. Parnassiinae, Stichel, H. 59. Lepidoptera, Fam. Papilionidae, Subfam. Zerynthiinae, Stichel, H. 60. Trichoptera, Ulmer, G.
305	Ent R	10	9	A	do.	Volume IX, 1907. do. FASCICULES, LXI-LXIV. 61. Hymenoptera, Fam. Trigonalidae, Schulz, W. A. 62. Hymenoptera, Fam. Ichneumonidae Subfam. Pimplinae, Schmiedeknecht, O. 63. Lepidoptera, Fam. Nymphalidae, Subfam. Dioninae, Stichel, H. 64. Coleoptera, Fam. Pselaphidae, Raffray, A.
306	Ent R	11	9	A	do.	Volume X, 1908. do. FASCICULES, LXV-LXXV. 65. Coleoptera, Fam. Brenthidae, Schönfeldt, H. von 66. Mallophaga, Kellogg, V. L. 67. Neuroptera, Fam. Coniopterygidae, Enderlein, G. 68. Diptera, Fam. Muscaridae, Subfam, Lauxaninae, Hendel, F. 69. Coleoptera, Fam. Curculionidae, Subfam. Entiminae, Bovie, A. 70. Coleoptera, Fam. Curculionidae, Subfam. Cryptoderminae, Bovie, A. 71. Coleoptera, Fam. Curculionidae, Subfam. Alcidinae, Bovie, A. 72. Orthoptera, Bovie, Locustidae, Subfam. Decticinae, Caudell, A. N.

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						73. Orthoptera, Bovie, Blattidae, Subfam. Phyllodromiinae, Shelford, R. 74. Orthoptera, Bovie, Nyctiborinae, Shelford, R. 75. Hymenoptera, Fam. Ichneumonidae, Subfam. Cryptinae, Schmiedeknecht, O. Volume XI, 1908.
307	Ent R	12	9	A	Wytsman, P.	do., FASCICULES, LXXVI-LXXXI. 76. Hymenoptera, Fam. Bethylidae, Kieffer, J. J. 77. Hymenoptera, Fam. Stephanidae, Kieffer, J. J. 78. Coleoptera, Fam. Erotylidae, Subfam. Languriidae, Fowler, W. W. 79. Diptera, Fam. Muscaridae, Subfam. Pyrgotinae, Hendel, F. 80. Hymenoptera, Fam. Scelionidae, Brues, C. T. 81. Anoplura, Torre, K.W. von, Dalla Volume XXII, 1908.
308	Ent R	13	9	A	do.	do. FASCICULES, LXXXII-LXXXVI. 82. Coleoptera, Fam. Carabidae, Subfam. Cicindelinae, Horn, W. 83. Coleoptera, Fam. Carabidae, Subfam. Omophroninae, Rousseau, E. 84. Coleoptera, Fam. Carabidae, Subfam. Promecognathinae, Rousseau, E. 85. Coleoptera, Fam. Carabidae, Subfam. Pamborinae, Rousseau, E. 86. Coleoptera, Fam. Carabidae, Subfam. Lorocerinae, Rousseau, E. Volume XIII, 1908-1910.
309	Ent R	14	9	A	do.	do. FASCICULES, LXXXVII-XCIII. 87. Homoptera, Fam. Aleyrodidae, Quaintance, A. F. 88. Coleoptera, Fam. Erotylidae, Subfam. Erotylinae, Kuhnt, P. 89. Coleoptera, Fam. Curculionidae, Subfam. Laemosaccinae, Bovie, A.

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						90. Orthoptera, Fam. Acridiidae, Subfam. Pyrgomorphinae, Bolivar, I. 91. Coleoptera, Fam. Curculionidae, Subfam. Belinae, Lea, A. M. & Bovie, A. 92. Coleoptera, Fam. Curculionidae, Subfam. Gymnetrinae, Bovie, A. 93. Diptera, Fam. Mycetophilidae, Johannsen, O. A.
310	Ent R	15	9	A	Wytsman, P.	Volume XIV, 1909. do. Fascicules, XCIV-XCVII. 94. Hymenoptera, Fam. Ceraphronidae, Kieffer, J. J. 95. Hymenoptera, Fam. Serphidae, Kieffer, J. J. 96. Diptera, Fam. Muscaridae, Subfam. Pterocallinae, Hendel, F. 97. Hymenoptera, Fam. Chalcididae, Schmiedeknecht, O.
311	Ent R	16	9	A	do.	Volume XV, 1909. do. Fascicules, XCVIII-CVII. 98. Coleoptera, Fam. Curculionidae, Subfam. Nanophyinae, Bovie, A. 99. Coleoptera, Fam. Curculioniadae Subfam. Brachycerinae, Bovie, A. 100. Lepidoptera Heterocera, Fam. Pterophoridae, Meyrick, E. 101. Orthoptera, Fam. Blattidae, Subfam. Epilamprinae, Shelford, R. 102. Hymenoptera, Fam. Formicidae, Subfam. Dorylinae, Emery, C. 103. Lepidoptera Heterocera, Fam. Geometridae, Introduction et Subfam. Brephinae, Prout, L. B. 104. Lepidoptera Heterocera, Fam. Geometridae, Subfam. Oenochrominae, Prout, L. B. 105. Hymenoptera, Fam. Thynnidae, Turner, R. E.

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						106. Diptera, Fam. Muscaridae, Subfam. Ulidiinae, Hendel, F. 107. Hymenoptera, Fam. Belytidae, Kieffer, J. J.
312	Ent R	17	9	A	Wytsman, P.	Volume XVI, 1910. do. Fascicules, CVIII-CXI. 108. Lepidoptera Heterocera, Fam. Orneodidae, Meyrick, E. 109. Orthoptera, Fam. Blattidae, Subfam. Blattinae, Shelford, R. 110. Coleoptera, Fam. Aphodiidae, Schmidt, A. 111. Coleoptera, Fam. Ipidae, Hagedorn, M.
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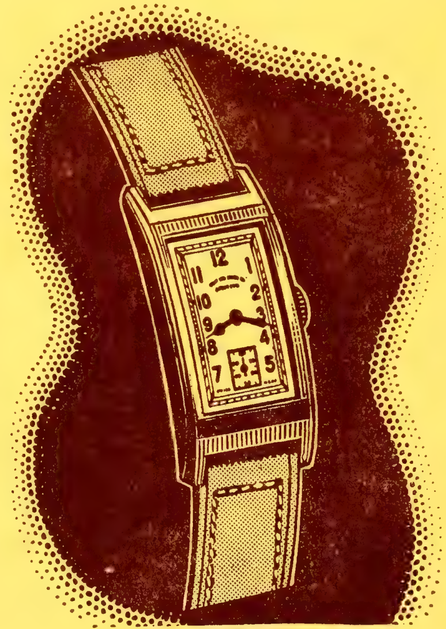

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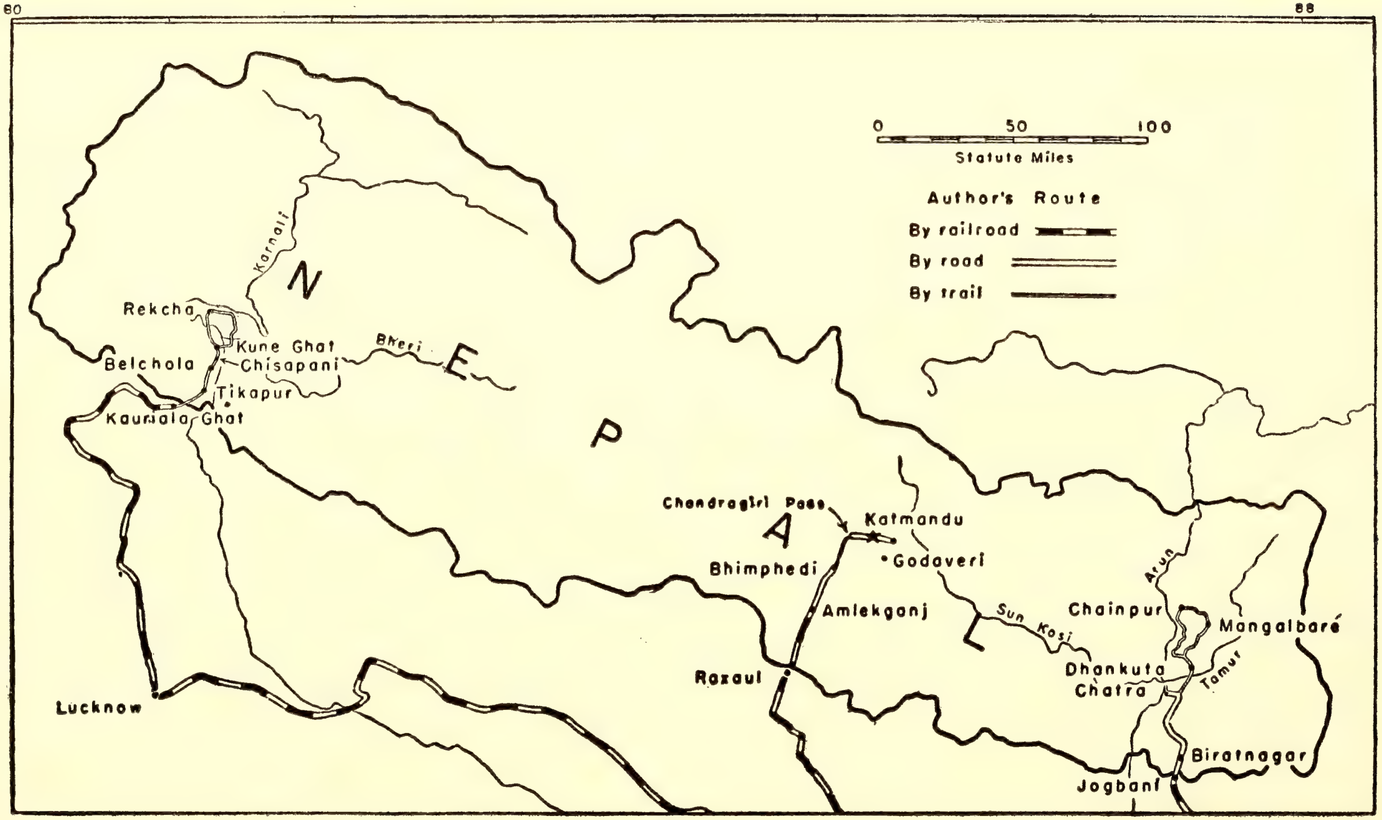
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Dhankuta
Chatra
Tamur
Biratnagar
Jogbani

NEPAL

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BIRDS FROM NEPAL, 1947-1949

BY

S. Dillon Ripley

(*With a map, 1 coloured and 2 black & white plates*)

Since the days of Brian Hodgson, that indefatigable worker on so many facets of natural history in the Himalayas, Nepal has been a sort of 'terra incognita'. The Central Valley containing the capital, Katmandu, and the routes leading up to it from the Indian plains, have been the only areas visited by naturalists, as they have been the only areas visited by foreigners, outside of the occasional invited big game shoots arranged by the Nepal rulers in the lowlands of the Terai. Aside from Sir Joseph Hooker's brief botanical explorations along the Tamur River in 1848, and one or two recent geological treks in eastern Nepal, no zoologists have been allowed to travel or study in Nepal, except in the Valley area, within a radius of fifteen miles of the capital, and the trail up. Until recently the best paper on the Valley was that of Surgeon J. Scully who was in attendance at the British Residency for two years and published a list of 300 species of birds from Nepal in *Stray Feathers* in 1879. Herbert Stevens visited the Sikkim Himalayas in 1911, '12 and '14, and crossed over into eastern Nepal for a short distance. His extensive collections were written up and published in the *Journal of the Bombay Natural History Society* in 1923-24. In 1920 and 1921 a small collection of birds was secured at the same time as the collection of mammals for the Mammal Survey of India was made by the Bombay Natural History Society's collector, Mr. N. A. Baptista, under the supervision of Colonel R. L. Kennion who was then British Resident. A comprehensive if conjectural list of the birds of Nepal was prepared by S. H. Prater for inclusion in Volume I of the book, 'Nepal' by Percival Landon, published by Constable and Co., London, 1928. Colonel F. M. Bailey, who was Minister in Nepal in the early nineteen-twenties, made a collection of birds which is at present being studied by Mr. N. B. Kinnear at the British Museum. More recently (in 1947) two collections have been made about the Valley and the trail leading to it by Dr. Walter Koelz, whose specimens are on deposit in New York and currently being studied by a number of students, and Mr. B. Biswas of the Indian

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Museum. In the summer of 1949 Mr. R. L. Fleming of Mussoorie collected some 600 specimens in the western Nepal districts of Palpa, and No. 4 West on the upper Pokhara-Mustang trail, and a party of British mountaineers, using one of our collectors, took a few specimens for the British Museum on the trail up to Gosainthan.

There are two valuable recent papers in the Bombay Natural History Society's journal of sight observations of Nepal birds, the first by B. E. Smythies, son of the well-known forest official of Nepal, and co-author of 'Birds of Burma', of birds observed during a walk along the pilgrim trail to Gosainkund (1948). The second is by Mrs. Proud, wife of the First Secretary of the British Embassy at Katmandu, on birds observed in the Valley (1949).

The collection reported on herewith is believed to be the most comprehensive made since Hodgson's time. The specimens collected number close to sixteen hundred, representing three hundred and thirty-one species and subspecies taken, with an additional fifty forms positively observed, making a total of three hundred and eighty-one. Of these, ten species and subspecies have not previously been recorded from Nepal. In addition eight subspecies have been previously described as new (1950).

COLLECTING LOCALITIES AND DATES

For convenience's sake I will divide the collecting localities into three groups: Central, West and East. The winter dates from November to February are in 1948-49, the April-May dates in 1947.

(A) *Localities in the Central area.*

Raxaul-Birganj. The border area of Nepal is totally indistinguishable in its general conditions from neighboring areas of Bihar. Open cultivation devoid of trees except for occasional mangos and groves of bamboo. Altitude 350 ft. above sea level. November 17-20.

Simra. A village about fifteen miles farther north-north-east in the Terai on the edge of the evergreen forest belt. Altitude 450 ft. November 18.

Sisagarhi. The height above Bhimpedi, sometimes called Chisapani Garhi where the first Rest House of the foot trail is located. On the southern slopes of the first Pass of the Mahabharat Range in light scrub, mixed with grass and pines. Altitude 5,000 ft. December 7, May 3.

Bhimpedi. A village at the head of the motor road and below the first pass on the Katmandu trail. Some evergreen tucked away in small ravines. The open areas are either cultivation, however, or mixed light scrub, grass and pine. Altitude 4,000 ft. May 3-5.

Kulikhani. A village in the Markhu Valley enroute to Katmandu. Open cutivation along an upper branch of the Bagmati River. Altitude 4,750 ft. November 22, December 6.

Chandragiri Pass. The last Pass before descending into the Central Valley of Nepal, the Valley of the capital, Katmandu, hereafter called the Valley. This Pass is well-clothed with evergreen, mixed oaks and rhododendrons and is one of the remaining forested areas within reach of Katmandu itself. Altitude 7,500 ft. November 22, December 6, April 17, May 3.

Naggerjung Hill. A hill about two miles northwest of Katmandu, called variously Nagarjong, Nagerjun, etc. The upper slopes are well forested, as the area is a Preserve, but constant cutting nevertheless still goes on. The biotope is mixed deciduous-evergreen, with pines (*P. longifolia*) on the S.E. slope. Altitude about 6,000 ft. November 25, April 12-20.

Godaveri. A spring about ten miles southeast of Katmandu where the ruling family have maintained another Preserve. The village lies in the shadow of Phulchok, one of the highest surrounding hills of the Valley, well clothed in evergreen forest. Our collecting was done from 5,500-6,500 ft. Spelt variously Godavari, Godavery, etc. November 26-28, April 25-29.

Pharping. An open cultivated area in the Valley about seven miles south of the capital at a point where the Bagmati River emerges through the surrounding hills. Altitude 4,200 ft. December 1-4.

Thimi. A village of pottery makers surrounded by open cultivation and small ponds and swamps five miles east of Katmandu. Altitude 4,500 ft. December 4.

Gokarna. A Preserve of the Rana family situated in the Valley about four miles to the east of Katmandu. Thick mixed deciduous and evergreen forest in a patch of about fifty acres surrounded by a wall. Altitude 4,700 ft. April 22-24.

Chitlang and Chisapani are two villages on the south side of Chandragiri Pass. The localities have mixed evergreen forest stretching up the hill-side, interspersed with patches of grazed-over scrub. Altitude 6,000-6,500 ft. April 17-May 1.

(B) *Localities in western Nepal.*

Kauriala Ghat is the railhead for the Oudh Tirhut Railway in Kheri District, U.P., fronting on the Nepal border at the Kauriala River bank, a tributary of the Karnali. The area is grazing land with patches of heavy second growth deciduous scrub. Altitude 400 ft. December 10, 11.

Tikapur, twelve miles north along the bank of the Kauriala River is a hamlet of the Tharu people on the edge of the Terai belt of deciduous forest. In addition to the heavy deciduous forest biotope, there was a light scrub forest consisting of *Acacia catechu,* and numerous bushes, characteristically *Zizyphus,* and tall grasses. This scrub occurred on the banks of the rivers and on small islands in the bed of the stream. It proved to be a favoured habitat of a number of warblers and babblers, and a few miles north, of the Scaly-bellied Woodpecker. Altitude 500 ft. December 12, January 5-10.

Belchola, a camping place on the bank of the Kauriala about six miles north of Tikapur, deep in the forest which by now had assumed a number of evergreen components. Altitude 600 ft. December 14, January 4.

Chisapani. A small group of huts at the gorge where the Karnali River emerges from the Siwaliks. Heavy forest, mixed evergreen and deciduous, with a fringe of the light acacia and thorny scrub growth along the river banks. Altitude 900 ft. The southern limit of many wintering montane birds. December 16-22, January 4.

Kune Ghat, Jammu Ghat, Guttu, Solta, Kachail were all hamlets in the 'duns' the flat interior valley behind the Siwalik ridge and south of the Mahabharat hills. The area was relatively untouched, although lumbering operations have begun under lease to an Indian firm. Here were giant primeval stands of the largest forest trees, *Shorea, Dalbergia, Eugenia, Bombax,* etc. The Karnali receives its principal tributary the Bheri River here. Altitude 1,000-2,000 ft. December 22-24, January 2-4.

Rekcha. A village where our party camped for nearly ten days. It is on the ridge of the Malka Danda, the first range to the north of the 'duns'. Cultivation was very heavy along these ridges and also to the north so that we camped here and made the best of what we could find in the way of the sparse evergreen forest patches available, mostly oaks and rhododendrons. The scrub and grassland remnants with open pine stands were combed for *Ophrysia,* but without success. Altitude 5,000 ft. December 25-January 2.

(c) *Localities in eastern Nepal.*

Biratnagar. The Nepal industrial town a mile north of Jogbani, the Oudh Tirhut Railway terminal facing the Nepal border in Bihar. The surrounding countryside is entirely under cultivation except for a few acres of woodland two miles northwest of the town. This stand is being cut daily. Altitude 250 ft. January 17-19.

Dharan Bazaar, the winter camp of the Governor of Dhankuta District is at the foot of the first range of the Mahabharat Lekh, just north of the six-mile wide band of Terai forest remaining in east Nepal. Conditions for hunting here range from open grazed land and scrub, to fairly heavy evergreen and deciduous forest south of the town. Altitude 1,000 ft. January 21-23, February 15-17.

Muhlghat, a village on the Tamur River, one of the seven Kosi feeders, in the 'duns'. Open scrub. Altitude 1,000 ft. January 24, February 14.

Dhankuta. The Provincial capital is surrounded by open cultivation and very little forest except a patch of pines north of the town. Altitude 4,000 ft. January 25.

Sindua, Chitré and Dur are hamlets along the main ridge, sometimes called the Patek Danda running northeast-southwest north of Dhankuta. Forest is not reached until an altitude of about 7,000 ft. when it begins sparsely, mostly the relics of old rhododendron groves, which gradually become thicker and more solid. Altitude 6,500-8,500 ft. January 26-29.

Tinjuré, Mangalbaré and Umling were place names only, lacking inhabitants, on the further northeastward extension of the main ridge

View of Mt. Kanchenjunga from the Southwest, taken from the ridge of the Tinjure Danda at Mangalbare showing the slopes of the hills covered with rhododendron forest. The lower slopes at about 7,500 ft. are the upper limit of cultivation, traces of which may just be made out in the clearings below the trees. Phalut appears at the extreme right of the picture.

Courtesy *National Geographic Magazine*

Typical forest remnants and scrub vegetation at Rekcha (5,000 ft.) in western Nepal. The trees are mostly oaks. The outer ridge in the background is the Siwalik Range, which here reaches a height of 5,500 ft.

Courtesy

Crossing the Bheri River in west Nepal at Jamu Ghat. The forest across the river was untouched and consisted of magnificent timber trees, *Shorea*, *Dalbergia* etc., a haunt of *Mulleripicus*.

National Geographic Magazine

Near Chisapani in the west Nepal Terai. In the foreground, the beginning of a sandy island usually covered with *Acacia* and *Zizyphus*, the haunt of numerous wintering warblers and babblers and the woodpeckers, *P. xanthopygaeus* and *D. nanus*.

north and east of Dhankuta, called the Tinjuré Danda. Thick rhododendron forest was interspersed with open patches of Alpine-type meadow land. On the tops of the ridge were the beginnings of silver fir (*Abies*) and yew, and groves of slim montane bamboo species. Altitude 8,100-9,400 ft. January 29-February 7.

Muhlkarkar, Mahdi, Birta and Chainpur were hamlets along the trail to the northeast down to the Arun Kosi River. Open cultivation with occasional patches of scrub and pines. No forest. Altitude 3,500-6,000 ft. February 8-10.

Along the valley of the Arun Kosi in the 'duns', a few birds were collected at localities known as Richavas and Mangma. Open cultivation with occasional patches of bushes. Altitude 1,150-2,500 ft. February 11-12.

Chatra, a village on the east side of the gap where the main Kosi River emerges from the hills into the Terai. An excellent collecting locality, for the Terai forest is here very thick and relatively undisturbed. Primary mixed evergreen and deciduous forest. Altitude 500 ft. February 17-21.

SPECIATION ALONG THE HIMALAYAN AXIS IN NEPAL

One of the problems which we set out to attempt to elucidate in this collection was the determination of the relationships of the fauna with the principal breaks in the east-west mountain axis. It is interesting to tabulate some of the data which we obtained. Listing the species which are residents along the south face of the Himalayan chain, I find that we have collected specimens of 143 such resident typically Himalayan species (I exclude from this grouping forms found all over the Indian plains and into the Peninsula, and Palaearctic forms).

Himalayan axis species collected		143
Of the above, most contained one subspecies throughout Nepal		111*
Species with two subspecies in Nepal, a western and an eastern subspecies		21
(*a*) Species in which the western subspecies occurs in Valley	14	
(*b*) Species in which the eastern subspecies occurs in Valley	4	
(*c*) Species with one subspecies in Nepal and a clinal or intermediate form in the western part of the country	1	
(*d*) Species with two subspecies in Nepal and a clinal or intermediate form in the western part of the country	1	
(*e*) Species with two subspecies and a clinal or intermediate form in the eastern part of the country	1	
	21	

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* The additional 11 forms not included here are local endemisms or those with continuous clines which do not break into subspecies.

From the above it becomes apparent that a clear two thirds or 67% of the endemic Himalayan axis forms collected in which two subspecies occur in the country, have a division between the forms in the eastern half of Nepal. This is certainly a significant amount beyond any doubt.

Correlated with the above is the fact that the following species taken by us are presumably found only in extreme eastern Nepal:

Malacocincla sepiaria abbotti
Macronus gularis rubricapilla
Paradoxornis poliotis humei
Muscicapa sapphira
Muscicapa (olivaceus) poliogenys
Parus rubidiventris beavani
Certhia familiaris mandelli? (see text)
Certhia nipalensis?
Anthreptes singalensis assamensis

The above forms have been collected only east of the Arun Kosi River. So have all the eastern subspecies of Himalayan species taken by us in Nepal. What has served then as an extrinsic barrier to promote speciation east and west of this zone? Geographically the area is a continuous sweep of hills, wooded to the same extent. Studying the recent geology of the Himalayas is no great help. The rivers in themselves are apparently rather recent and so not barriers as they may be in other parts of the world. In a recent study of speciation in the Mishmi Hills of eastern Assam with Sálim Ali (1948), we came to the conclusion that the Brahmaputra River is not a great barrier, being too recent a feature, presumably, in contrast to its non-Himalayan feeder the Lohit. What other barriers then exist, if not geographical ones, in the neighborhood of the Kosi River valley, the apparent locus of the division between eastern and western Himalayan bird subspecies?

In the whole sweep of the Himalayan range through Nepal there is only one easily perceptible and presumably significant climatological change and that is the isohyet which passes through the 87th parallel. East of 87° E. long. the annual rainfall is about 75 inches per year. West of this isohyet the annual rainfall is reduced to 50 inches per year. I should say, therefore, that from the above evidence, the most distinctive 'break' in the distribution of the avifauna from east to west in Nepal occurs in the valley of the Arun Kosi River which runs nearly north and south very slightly to the east of the 87th parallel.

A second interesting correlation climatically with speciation in the Nepal area is the fact that at the 80th parallel or slightly to the west of it, there is a decided change in the annual temperature range, although the annual rainfall of 50 inches per year remains the same. The Himalayan zone to the east of 80° E. as far as 87° E. receives the major portion of the annual rainfall in the Monsoon but an effective amount also falls from December to May. Winter in the lowlands and foothills is cold (60-70° F.). The daily range of temperature is large except during the Monsoon (more than 25° F.). Relative humidity is high during Monsoon and winter (more than 65%), but less in other periods.

West of 80° E. (that is to say, west of the Nepal-Kumaon border), the annual rainfall occurs almost wholly in the Monsoon season. It is very cold in winter (less than 60° F.). The daily range of temperature is moderately large (20-25° F.). Relative humidity is high only during the Monsoon. The plains do not become hot quite as early. It is perhaps significant that a number of forms seem to be confined to this area from 80°-87° as follows:

Megalaima zeylanica rana (western Nepal only)
Pomatorhinus erythrogenys ferrugilatus (central and west Nepal)
Acanthoptila nipalensis (west Nepal)
Garrulax striatus vibex (central and west Nepal)
Garrulax rufogularis grosvenori (west Nepal)
Heterophasia capistrata nigriceps (central and west Nepal as far as Kumaon)
Phylloscopus pulcher erochroa (central Nepal)
Phyllocopus maculipennis centralis (central Nepal)
Certhia himalaya infima (west Nepal)

Of the above eight subspecies, five differ from their nearest relatives by color alone, being in every case paler than more eastern populations, and if relatives exist to the west darker than these western forms. In the same way, those three races that differ in size, are larger than the populations to the east, and smaller than those to the west. *Acanthoptila*, the Spiny Babbler, alone has no close relatives, being apparently a relict form intermediate between the genera *Turdoides* and *Garrulax*.

In addition to these populations to which names may be ascribed on the basis of color or size differences, there are five species in which intermediates occur between two recognised sub-species in western Nepal, three species in which intermediate populations occur between recognised sub-species in eastern Nepal, and one intermediate population in central Nepal between two recognised sub-species found on either side. Thus there are a total of nine populations in which a continuous cline of color or size prevents the clear demarcation of the population into sub-species. All vary as above, being darker or smaller or both as specimens are examined farther to the east at any point in the cline.

Thus the external evidences of speciation examined all follow Gloger's rule, indicating an adaptive significance in the possession of darker color in more humid areas. In this connection it is worth pointing out another rule that seems to apply in Continental areas, if not on islands: that is that birds from more humid areas tend to be smaller than birds from drier areas.

From the above evidence I would hazard the opinion that the climatic influences in the Nepal area of the Himalayas have been more effective in promoting speciation than have any specific geographical or other extrinsic barriers. Of course the very fact that the zone in which these forms live is a narrow one, a long rectangular strip along the south face of the Himalayas, is in itself a sort of barrier, tending to reduce gene flow. But given this continuous strip, it would appear that the avian populations have developed a certain definite tolerance for conditions as found within these climatic micro-zones.

In this connection it is worth noting that the climatic changes mentioned above do not occur in a straight north-south line, all areas to the east of such a line having climate *a*, all areas to the west climate *b*. Any line demarcating climatic change along the Himalayas, just as any isohyet, bends, so that it runs roughly in a northwest-southeast direction. In our collecting in western Nepal we were able to observe that the distribution of subspecies follows this general pattern in an accurate way. Thus *Megalaima zeylanica caniceps, M. z. rana,* and *M. z. hodgsoni,* apparently replace each other diagonally following such a northwest-southeast line. The race *caniceps,* found in the mountains in the west in the colder area, appears only in the west Nepal Terai, while *rana* replaces it in the west Nepal hills. Then by the time one reaches central Nepal, *hodgsoni* is the race of the hills, but, moving farther east again to east Nepal, *hodgsoni* has disappeared from the hills and is found only in the Terai, and has become a lowland bird. In somewhat the same way *Certhia himalayana infima* and *Sitta castanea cinnamoventris* are able to winter in the forest belt of the Terai in western Nepal, whereas apparently farther to the west they must winter much higher in the foothills.

Aside from the natural climatic conditions, it will be most interesting to observe in future what effect the tremendous progressive deforestation will have on the avifauna and the mammalian fauna of Nepal. The lowland forest in the Terai is now reduced to a continuous belt ranging from six to ten miles wide along the northern limit of the Terai. This area will probably be somewhat preserved in future although much of the primary tree growth has already been lumbered. It is the main big game hunting ground of the ruling family. Farther north in the 'duns', the interior valleys, lumbering is proceeding at a rapid rate, and only along the Karnali did we find any virgin timber left. From 1,000 ft. up to over 7,000 ft. throughout the country, intensive agriculture of a shifting nature is practised. The slopes are normally so steep that in many places only one or two crops can be secured from the newly cleared land before the monsoon run-off has carried away the topsoil. Thus vast areas become merely barren slopes of rock shale and gravel and avalanches are common. We found as a result that in many places mid-montane zone birds either did not exist, or could occasionally be glimpsed scurrying from bush to bush as if their lives depended on it, which possibly they did. It seems inevitable that jungle-haunting birds at this elevation will eventually become extinct over large areas. It will be interesting to note this progress, as it may well represent the creation of new artificial geographical barriers with long range climatic and speciation effects.

ACKNOWLEDGMENTS

I must express my deep gratitude to the authorities of the National Geographic Society who have allowed me to use photographic and other material for this paper, and who, along with the Smithsonian Institution and Yale University, supported our second longer trip to Nepal. The help rendered by these three Societies made our Expedition possible. To the Bombay Natural History Society my thanks are owed for many favors, not least of which was the recruiting for us of two skinners, Tony Mattos and John D'Souza. Finally my especial thanks are due to the two rulers of Nepal during my visits, Their Highnesses Maharajah Padma Shamsher J. B. Rana, and

Maharajah and Supreme Commander-in-Chief Mohun Shamsher J. B. Rana, for the many kindnesses they extended to our party, and for their willingness to allow us to explore parts of their country. To them and to the many officials who served them and assisted us on numerous occasions I am most grateful, and I hope that this paper will be a small tribute to their sponsorship of zoological research.

LIST OF THE BIRDS

COLYMBIDAE

Podiceps ruficollis: Little Grebe.

The Little Grebe was seen occasionally on some of the small ponds in the lower Terai near the Indian border.

PHALACROCORACIDAE

Phalacrocorax carbo: Large Cormorant.

Adults and immature birds were seen flying up the Karnali River in the 'duns' the inner valleys, in early January.

ANHINGIDAE

Anhinga rufa: Indian Darter.

Common in small ponds in the Terai.

ARDEIDAE

The Gray Heron (*Ardea cinerea*) and the Purple Heron (*Ardea purpurea*) were seen along the rivers in the Terai. The little Green Heron (*Butorides striatus*) was seen but not collected on the Kosi River in the 'duns'.

Ardeola grayii (Sykes): Indian Pond Heron.

A single male in sub-adult plumage, but entering breeding condition was collected April 19 at Gokarna. Soft parts: iris yellow; ocular skin yellowish-green; bill, upper mandible black, lower greenish-yellow; legs greenish-yellow. The species was common at all altitudes up to 5,000 feet.

Egretta garzetta garzetta (Linnaeus): Little Egret.

A female in breeding condition was taken at Thankote in April. Soft parts: iris gray with veins of purple; ocular skin bluish-purple; bill black, base of upper mandible bluish-purple, lower mandible with a small basal area of bluish-purple; legs black, feet orange-yellow.

The Large Egret (*Egretta alba*) and the Intermediate Egret (*Egretta intermedia*) were both seen in the Terai, but not higher.

Bubulcus ibis coromandus (Boddaert): Cattle Egret.

The commonest egret in Nepal, this species was seen from the Terai up to 5,000 ft., particularly in the Central Valley.

CICONIIDAE

The Open-bill (*Anastomus oscitans*), the White-necked Stork (*Ciconia episcopus*), the Black-necked Stork (*Xenorhynchus asiaticus*) and the Adjutant (*Leptoptilos dubius*) were all seen in the Terai in all areas where bodies of water occurred in open country, but none of the species were common or plentiful.

THRESKIORNITHIDAE

Pseudibis papillosa (Temminck) : Black Ibis.

A male was shot out of a wheeling flock at Tikapur, the only time the species was seen. Wing, 380 mm. Soft parts: iris brownish-yellow; crown and nape wattles coral red; face black; bill pale grayish-brown; legs pinkish-coral.

ANATIDAE

The Bar-headed Goose (*Anser indicus*) was seen on the Karnali River near the Indian border in mid-December. The Whistling Teal, presumably the Lesser (*Dendrocygna javanica*), was common locally at Chatra on the Kosi River in February.

Tadorna ferruginea : Ruddy Sheldrake.

The Brahminy Duck was seen in considerable flocks on the Karnali in the Terai during December and January, and on the streams of the Central Valley as late as April.

Migratory river duck of several species were seen in the Central Valley from November to April and locally on the big rivers in east and west Nepal. These consisted of the Pintail (*Anas acuta*), in the Central Valley only, Green-wing Teal (*Anas crecca*), Gadwall (*A. strepera*) both in the Central Valley and on the Kosi River, and Widgeon (*A. penelope*) and Gargany (*A. querquedula*) on Commanding General Kaiser Shamsher J. B. Rana's pond at Katmandu.

Of the pochards, the Red-crested Pochard (*Netta rufina*), the Common Pochard (*Aythya ferina*) and the Tufted Duck (*Aythya fuligula*) were all seen around the Central Valley in ponds and on the rivers.

Mergus merganser : Goosander.

Common along the Karnali at Chisapani and in the 'duns'. The females had arrived in December. Adult males were not seen until January 6th.

ACCIPITRIDAE

Elanus caeruleus vociferus (Latham) : Black-winged Kite.

This pretty and ubiquitous species was common in the Terai along the forest edges. A male from Tikapur was coming into breeding condition in January.

Milvus migrans lineatus (J. E. Gray) : Black-eared Kite.

A breeding and a non-breeding male were collected at Thankote and Naggerjung in April, and a non-breeding bird at Rekcha. They measure: wing ♂ ♂ 464, 472, 478 mm.

Accipiter nisus melanoschistus Hume : Indian Sparrow Hawk.

A female with a wing measurement of 254 was shot at Tinjuré February 4th. The bird was attacking a large hill barbet when secured. Soft parts; iris orange-yellow; bill black, cere greenish-yellow; legs yellow.

Accipiter badius dussumieri (Temminck) : Indian Shikra.

Most hawks of the *Accipiter* group seemed rare in Nepal. A male Shikra was taken in a clump of trees near Biratnagar, the last clump in the vicinity of that rapidly expanding town. Soft parts: iris red; eyelid and cere yellow; bill black, basally gray; legs dull orange-yellow. Wing 186.5.

Accipiter trivirgatus indicus (Hodgson): Northern Indian Goshawk.

An adult female taken by us at Chatra February 17th, appears to be the first specimen of this Goshawk collected since the typical series by Hodgson's collectors. Measurements: wing 260; tail 203; tail index (length of tail in percent of wing length) 78; wing tip index 23.8. In size this specimen compares well with the measurements given by Mayr (1949), for the race. Soft parts: iris orange-yellow; bill black, cere yellow; legs yellow. The specimen was taken in thick forest.

Buteo hemilasius Temminck & Schlegel : Upland Buzzard.

While out shooting Rock Pigeons near Thimi in the Central Valley in December, a female Buzzard landed on a pile of pigeon feathers just after I had picked up the dead bird in an open field. Apparently the bird saw the pigeon fall to the ground and missed seeing me pick it up. In its actions and looks the Buzzard resembled a young, uneducated eagle.

Butastur teesa (Franklin) : White-eyed Buzzard-eagle.

A single male was taken near Dhankuta at 4,000 ft. in open country. Wing 283.

Hieraaëtus pennatus (Gmelin) : Booted Eagle.

A female with a wing measurement of 397 was shot out of a large tree at Tikapur.

Ictinaëtus malayensis: Black Eagle.

The Black Eagle was seen at 5,000 ft. in west Nepal, one of a number of the larger birds of prey that were seen but flew out of reach of the collectors.

Haliaeetus leucoryphus (Pallas) : Pallas's Fishing Eagle.

A female, one of a pair of these rather common and unsuspicious birds was taken at Tikapur in December. These birds are prominent because of their presence atop some giant silk-cotton tree and their harsh grating monotonous call. Wing 612, tail 300, tarsus 104, culmen (from cere) 51. Soft parts: iris dirty yellow, mottled with brown.

Pseudogyps bengalensis (Gmelin) : White-backed Vulture.

This species was common in the Valley, especially near the rivers. A non-breeding young male was taken at Gokarna in April. Wing

590. The other species seen in the Valley was the Long-billed Vulture (*Gyps indicus*) but no specimens were secured. The Bearded Vulture (*Gypaëtus barbatus*) was seen on the ridge above Dhankuta at 6,500 ft. in early February, but our attempts to collect these birds resulted in a rattling noise as our shot-gun pellets struck their wing quills. There was no sign of the shots taking effect on the soaring birds.

Circus macrurus (S. G. Gmelin): Pale Harrier.

A male was collected at Dharan Bazaar. The Pied Harrier (*melanoleucus*) was seen in the central Nepal Terai in November.

Spilornis cheela cheela (Latham); Crested Serpent-eagle.

A male was taken on Naggerjung in April. Wing 495. Soft parts: iris yellow with brown mottling; bill basally gray, distally black, cere yellow; ocular skin whitish-yellow; legs light yellow.

PANDIONIDAE

Pandion haliaëtus haliaëtus (Linnaeus): Osprey.

A single female was seen and secured at Tikapur. Ospreys were also seen on the Kosi at Chatra.

FALCONIDAE

Microhierax caerulescens caerulescens (Linnaeus): Himalayan Red-legged Falconet.

The Falconet is a jungle bird, found by us near Dharan Bazaar and at Chatra. One bird was sitting near a hole in a twenty-foot dead tree, possibly a nesting site. Wing ♂ 101, o (= ♀) 111. Soft parts: iris brown; bill basally yellowish-green, distally black; legs blackish-slate.

Falco tinnunculus interstinctus McClelland: Himalayan Kestrel.

The commonest hawk in Nepal, seen from the Terai up to 5,500 ft., in open country. Soft parts: iris brown; cere and ocular area yellow; bill yellowish-slaty, black tip; legs orange-yellow. Wing ♂ 236-264; ♀ 243-255.

PHASIANIDAE

Francolinus francolinus: Black Partridge.

Common in the Terai and up through open areas in the 'duns', the Black Partridge has even invaded the Central Valley, probably recently since the great increase in cultivation. Not collected by us, but its characteristic syncopated whistle heard principally in the western and central Terai.

Francolinus pondicerianus interpositus Hartert: Northern Gray Partridge.

A female was taken at Kauriala Ghat, December 11.

Arborophila rufogularis rufogularis (Blyth): Rufous-throated Hill Partridge.

This was the only partridge secured at Rekcha, a place where we hoped in vain to find the Mountain Quail (*Ophrysia*), the 'sano kalo titra' of the Nepalese. Trappers went out locally in Dailekh District for us, looking for the latter species to report later that they could only secure this common Hill Partridge.

The Hill Partridge is deceptive to the naked eye. In the open it looks big when it flies, almost as big as a hen kaleej, but in thickets it appears as small as a quail. These birds were mostly secured in thick secondary scrub composed of *Strobilanthes, Quercus* seedlings, *Randia* and other thorny plants. Their calls were heard at Godaveri in April but none were secured. The birds were not calling at Rekcha in December. Wing ♂ 141; ♀ 126, 137. Soft parts: iris brown; ocular skin pinkish red; bill dark brown; legs dull coral red.

Tragopan satyra: Satyr Tragopan.

Near Mangalbaré we found a small heap of feathers belonging to a cock bird of this species, evidently killed by a fox or carnivore. These birds have been so much shot and trapped by the local people that they have now retreated above 10,000 ft. in east Nepal. The Impeyan Pheasant (*Lophophorus*) was not met with by us although it was supposed to occur near Mangalbaré. Birds are sometimes brought down from above Katmandu by trappers. Above Rekcha we were told that the Cheer Pheasant (*Catreus*) occurs although we did not get up high enough to enter its range.

Lophura leucomelana leucomelana (Latham): Nepal Kaleej.

Several kaleej were taken in the Central Valley, and the species was seen briefly in both eastern and western Nepal, although not collected. Wing ♂ 226, 236; ♀ 198-210. There is considerable variation in the color of the females although the pale edgings to the feathers are constant. Birds were breeding in April. In the Central Valley the kaleej is found in all the wooded preserves, particularly round Godaveri. Their alarm calls are often heard there in the thick scrub and they come out to feed in early morning on the trails. I saw two cock kaleej fighting at Chisapani in mid-December, but was unable to secure one. In western and eastern Nepal the species seemed uncommon.

Gallus gallus murghi Robinson & Kloss: Red Junglefowl.

The junglefowl was very common in the Terai where it seemed partial to the scrub at the forest edges, particularly the prickly 'jhaveri' or 'jherberi' (*Zizyphus*) bushes with their haw-like fruits. From west to east there is a cline in coloration of the neck hackles of the males collected by us, those from east Nepal being more orangey at the tip, more like *spadiceus,* with a reduced wattle also. This cline evidently culminates in northeastern Assam where Sálim Ali and I collected the Burmese race, *spadiceus* (1948). The same holds true for the females which become considerably darker in tone of general coloration from west to east, particularly in Assam. Soft parts: iris pale brown; wattles (♂) pink, pale whitish spot on ear; bill dark brown; legs blackish-brown.

TURNICIDAE

Turnix suscitator plumbipes (Hodgson): Himalayan Bustard-Quail.

The Bustard-Quail was found by us only at Dharan Bazaar. A pair (the female had not quite attained the adult black throat), measure: wing ♂ 87, ♀ 92.5, and agree in color with Assam birds.

GRUIDAE

Grus grus: Common Crane.

The Common Crane was seen at Kauriala Ghat on the river, where it flew up and down in a morning and evening flight. The Sarus Crane (*G. antigone*) also occurred in the vicinity. The Demoiselle Crane (*Anthropoides*) is found regularly as a migrant in the Central Valley in mid winter and again in early spring.

CHARADRIIDAE

Lobivanellus indicus indicus (Boddaert): Red-wattled Lapwing.

Common along streams in open cultivated areas in the Terai. Wing ♂ 217, 231.5; ♀ 215-22.

SCOLOPACIDAE

Tringa erythropus, T. nebularia, T. ochrophus, and *Actitis hypoleucos* were all common on the flats along the Karnali and Kosi Rivers from December through February.

Capella gallinago gallinago (Linnaeus): Fantail Snipe.

This species, along with the Pintail (*C. stenura*) and the Jack Snipe (*Lymnocryptes minima*) is found in the Central Valley in winter. Mr. Roy Kilbourne of Katmandu reported the Fantail to be the commonest of the three, but the numbers of all are severely reduced, according to Mr. Kilbourne's records of twenty years ago. The Wood Snipe (*C. nemoricola*) is found singly in the wooded swamps around the edges of the Valley, and Mr. Kilbourne has shot one or two each year.

Scolopax rusticola rusticola Linnaeus: Woodcock.

The Woodcock is not now very common in the wooded foothills about the Central Valley where it was common not long ago, according to Mr. Kilbourne. A pair were observed by us in a small swampy depression at Mangalbaré in January, and the male was caught later in one of my bird nets.

RECURVIROSTRIDAE

Ibidorhyncha struthersii: Ibis-bill.

A flock occupied the shallows near the rapids of the Kosi at Chatra while we camped there in February.

BURHINIDAE

Burhinus oedicnemus indicus (Salvadori): Indian Stone-Plover.

Stone-Plover were in pairs running about on the sandy banks of the Karnali and its tributary the Kauriala River in the lower Terai. Soft parts: iris yellow; eyelid and base of bill yellow; remainder of bill black; legs greenish-yellow.

GLAREOLIDAE

Glareola lactea: Small Indian Pratincole.

Seen but not collected on the Kosi River near Chatra in February.

LARIDAE

Sterna aurantia Gray: Indian River Tern.

The River Tern was common on the big rivers in the Terai. Soft parts: iris brown; bill rich orange-yellow; legs light coral red. This, the Black-bellied (*melanogaster*), and the little Ternlet (*albifrons*) were all seen on the Karnali and the Kosi.

COLUMBIDAE

Sphenurus sphenurus sphenurus (Vigors): Wedge-tailed Green Pigeon.

Seen at fairly high altitudes in central and eastern Nepal. Collected on the Chandragiri Pass and at Mangalbaré in rhododendron forest. Soft parts: iris orange; bill greenish-blue; legs cherry red.

Treron phoenicoptera phoenicoptera Latham: Bengal Green Pigeon.

A pair were taken at Tikapur where this species was fairly common in the trees which were covered with a heavy growth of vines, apparently fruiting. Wing ♂ 190, ♀ 183. Soft parts: iris orange-red, inner blue ring; bill greenish-gray; legs yellow.

Columba livia intermedia Strickland: Indian Blue Rock Pigeon.

Common in the Central Valley around paddyfields. Birds were breeding in April. Many live half wild about the houses of the smaller towns like Thimi and Thankote. Soft parts: iris reddish-yellow; ocular skin light gray; bill and cere grayish-black, posterior half of cere dirty white; legs dark red.

Columba hodgsonii Vigors: Speckled Wood-pigeon.

Two females were taken out of a small flock at Godaveri, April 25, 1947. This species was seen also at the Chandragiri Pass in May, but not met with elsewhere in Nepal at other seasons. Like so many pigeons, it is apparently a great wanderer, and may occur at any altitude above 5,000 ft. at any time. Soft parts: iris grayish-white; ocular skin gray; bill, basally purple, distally black; legs brownish-yellow, nails yellow. Wing (worn) 236, 237.

Columba pulchricollis Hodgson: Ashy Wood-pigeon.

This beautiful pigeon was not uncommon in the Valley at Gokarna and other heavily wooded preserves; but was difficult to observe as it sits very inconspicuously indeed in the high trees. A breeding male was taken at Gokarna in April. At Mangalbaré the species was common, and a subadult female was collected February 3rd. This bird is dark gray above, paler on the head, with blackish tail, with pale ecru-drab on the throat and pale cinnamon on the belly and under tail coverts. The breast is gray with a small amount of iridescence, and the abdomen gray with cinnamon tips to the feathers. Wing ♂ 211.5, 216, ♀ 215, (subad.) 183. Soft parts: iris white, grayish-white, whitish; ocular skin gray; bill (breeding ♂) basally grayish-purple, distally grayish-green, (non-breeding ♂ and ♀) cherry-red, greenish tip, (subadult) bluish-white; legs (breeding ♂) fleshy purple. (non-breeding ♂ and ♀) pinkish red, (subadult) pale pink.

Macropygia unchall tusalia (Hodgson): Bar-tailed Cuckoo-dove.

The big Himalayan Cuckoo-dove is a rather difficult bird to collect and doubly difficult to skin due to its habit of losing a good part of its skin and feathers on its way down from a tall tree. We found it only near Mangalbaré from 8,500 ft. up, although I saw it flying near the Chandragiri Pass. Soft parts: iris pink (once brown); bill black; legs dull cherry-red. Wing ♂ ♂ 196-209.

Streptopelia orientalis meena (Sykes): Rufous Turtle-dove.

Breeding males were collected about the Central Valley in forested areas in April. Their unusual, rather growling calls were heard in light secondary scrub, and cut-over forest. These specimens belong to the western form. Soft parts: iris orange, ocular skin reddish-purple; bill horn, cere grayish-purple; legs reddish-purple. Wing ♂ ♂ 189-192.

Streptopelia orientalis agricola (Tickell): Eastern Rufous Turtle-dove.

Breeding birds and young of this race were taken at all altitudes in eastern Nepal from 1,000 to 8,500 ft. in January and February. Wing ♂ 181-189, ♀ 179-181. Soft parts: iris orange; bill basally purplish, distally horn; legs dull purplish-red. Immature birds were as follows: iris orange, eyelids purple; bill brownish-black, (older) purplish-gray; legs grayish-purple, (older) purple.

Streptopelia decaocto decaocto (Frivalszky): Ring Dove.

Common in the Terai in cultivated areas. A male taken at Birganj in November was in breeding condition.

Streptopelia chinensis suratensis (Gmelin): Indian Spotted Dove.

Common from the Terai up to the Central Valley. Breeding birds were shot in January, March, April and December. Soft parts: iris pinkish-red, eyelids pinkish; bill black; legs dull cherry. Wing ♂ 137-144, ♀ 140, 143.

Chalcophaps indica indica (Linnaeus): Emerald Dove.

This little familiar ground dove was common in the Terai and the forests of the 'duns'. A subadult female was taken in January, a female coming into breeding condition in February. Soft parts: iris brown; bill (♂) coral red, (♀) basally purple, distally pink, (im. ♀) purplish-brown; legs (♂) purplish-red, (♀) purple, (im. ♀) grayish-purple; nails brown.

PSITTACIDAE

Psittacula eupatria nipalensis (Hodgson): Large Indian Parakeet.

Two females were taken in the west Nepal Terai have wing measurements of 203, 212. Soft parts: iris yellowish-white; bill red; legs gray. This species seems to be local, confined to fairly heavy forest, or in proximity to heavy forest, and a wanderer in search of suitable fruiting trees.

Psittacula krameri borealis Neumann: Eastern Rose-ringed Parakeet.

All the specimens of this parakeet collected in the Nepal Terai have the lower mandible red, brownish-red, purplish, or, in one case a female taken at Birganj, brownish-black. On this evidence the birds would seem to be *borealis*. In any case they are all large, wing ♂ 170-177. Birds were breeding in January and February in east Nepal. We found it common in the Terai in light forest.

Psittacula cyanocephala cyanocephala (Linnaeus): Blossom-headed Parakeet.

A male was taken in the Terai at Dharan Bazaar. Wing 143. Seen up to 6,000 ft.

Psittacula himalayana himalayana (Lesson): Slaty-headed Parakeet.

Peters (1937) points out that *himalayana* (Lesson) replaces *schisticeps* Hodgson.

Two specimens were shot out of a single flock seen at Rekcha December 27. The species was not otherwise observed. Soft parts: iris white; bill, upper mandible basally cherry, tip creamy yellow, lower mandible yellow; legs light greenish-gray.

CUCULIDAE

Cuculus varius Vahl: Common Hawk-cuckoo.

An immature male was taken at Birganj in November.

Cuculus micropterus micropterus Gould: Indian Cuckoo.

Indian Cuckoos were calling in the trees in wooded area in the Central Valley in late April, but the two males collected by us were not in breeding condition. Wing 190, 191. Soft parts: iris light brown, eyelids yellow; bill, upper mandible black, lower basally yellow, distally gray; legs yellow.

Cuculus poliocephalus poliocephalus Latham: Small Cuckoo.

I shot a single female in a gorge on Naggerjung in mid-April. The rectrices were in moult. Wing 171. Soft parts: iris white with a brown ring; bill, upper mandible black, lower greenish-gray; legs yellow.

Surniculus lugubris dicruroides (Hodgson): Indian Drongo-cuckoo.

Common in wooded places in the Central Valley. A breeding male, hawking for insects like the Ashy or Bronzed Drongo, was taken on the trail above Bhimpedi on May 3. Wing ♂ 140.5-147.5.

Eudynamis scolopacea scolopacea (Linnaeus): Koel.

A breeding male was collected April 12 at Naggerjung, and a heavily moulting male at Gokarna in late April. Wing ♂ 189 (worn), 202.

Rhopodytes tristis tristis (Lesson): Himalayan Green-billed Malkoha.

Seen at Bhimpedi, and collected at Chatra and up the Kosi and Tamur Rivers. Wing ♂ 169-176; tail ♂ 371 (Moult), 380, 383.5; white on second outermost rectrix 18-22. These measurements are slightly different from those given by Mayr (1938), notably in the shorter tail. These specimens and a few newly-collected birds from the Khasia Hills (wing 164-170) incline me to feel that *saliens* as a subspecies must depend on a smaller wing measurement alone as I can see no constant color differences. Mayr (l.c.p. 306) gives wing measurements for his *saliens* of 152-163.

Soft parts: iris dark brown; eyelid dark red; bill chartreuse green, legs dark greenish slate.

Taccocua leschenaulti infuscata Blyth: Hill Sirkeer Cuckoo.

Common in the western Terai in open country, often seen creeping along in overgrown fields or flying across a short stretch of open paddy. One bird scared one of our elephants by bursting out of the grass almost at its feet in the manner of a pheasant. Wing ♂ 164, ♀ 160. Soft parts: iris brown; bill cherry-red, tip yellow; legs grayish-blue.

STRIGIDAE

Otus asio (bakkamoena auct.): Collared Scops Owl.

Heard but not collected near Chatra in February.

Bubo zeylonensis leschenault (Temminck): Bengal Fishing Owl.

A rather diurnal species found by us in the Central Valley at Gokarna and in the western Terai. A male and female measure; wing ♂ 405, ♀ 389. Soft parts: iris dark yellow; bill greenish-gray, cere horn; legs light greenish-yellow, gray.

Glaucidum brodiei brodiei (Burton): Collared Pigmy Owlet.

Taken near Chandragiri Pass in March.

Glaucidium radiatum radiatum (Tickell): Jungle Owlet.

Found in the Terai right up to the foothills. Birds were coming into breeding condition as early as January 8, and were in full breeding condition in February. The species has a characteristic call, closely related to that of the Barred Owlet. Soft parts: iris yellow, eyelid greenish-yellow; bill greenish-yellow; legs yellowish-white, greenish-yellow. Wing 124-129.

Glaucidium cuculoides cuculoides (Vigors): Western Barred Owlet.

The Barred Owlet is possibly somewhat migratory in an altitudinal sense. We found it from the foothill edge of the Terai (January), up to 9,000 ft. The species seems to breed later than *radiatum*, and thus may occur on the edges of the latter's territory at times. But at these times *cuculoides* itself is apparently not in breeding condition, and moves into the hills when it is coming into its breeding cycle in March and April, thus removing itself as a marginal ecological competitor with *radiatum*.

A bird from Birta in east Nepal is approaching *rufescens* (Ripley 1948 c) in size and color, but still lies within the range of *cuculoides*. Soft parts: iris yellow; bill greenish-yellow, greenish; legs yellowish green, greenish-yellow. Wing; 5 ♂ ♂ and ♀ ♀ 142-156 (ave. 150.8).

Nepal name, 'latakoserai'.

Ninox scutulata lugubris (Tickell): Indian Brown Hawk-owl.

A male taken at Tikapur measures; wing 217, tail 133, culmen (from cere) 12. Soft parts: iris yellow; cere green, bill white; legs yellow. The bird was hawking after insects at dusk along the river bank.

Athene brama indica (Franklin): Northern Spotted Owlet.

The agitated screaming of these owlets was our first avian welcome in Nepal. They inhabit crevices in the Nepal Guest Houses at Raxaul and at Katmandu. A series from both places measure; wing ♂ ♂ and ♀ ♀ 152-166. Soft parts: iris yellow; bill yellowish-green, cere brownish-green; feet light brownish-green.

Strix ocellata, the Mottled Wood Owl was probably heard in the west Nepal Terai and in the foothills in eastern Nepal if my interpretation of its call is correct, a single note rather like that of the Spotted Deer or Chital. *Strix aluco*, the Himalayan Wood Owl was heard at Mangalbaré, a pleasant two-syllable note, *'who-whooo'*, but our efforts to locate it at night were unsuccessful.

CAPRIMULGIDAE

Caprimulgus indicus hazarae Whistler and Kinnear: Himalayan Jungle Nightjar.

A single specimen of this nightjar was collected at Chatra on an open road near the river in February. The *'chuck-er chuck-er'* call was heard both there and at Belchola in the western Tarai. Soft parts: iris reddish-brown; bill blackish-horn; legs brown.

Caprimulgus macrurus albonotatus Tickell: Horsfield's Nightjar.

Collected at Chatra where they sat commonly on the road at nightfall. These specimens belong to the dark, blackish phase and are males in breeding condition, on February 21. Wing: 207, 216. Soft parts: iris and feet brown; bill brown, tip black. At night the iris and of this species shines pinkish-red, whereas in our experience the eyes of the preceding form, *indicus*, reflect whitish in the light of a flashlight.

MICROPODIDAE

Apus affinis nipalensis (Hodgson): Nepal House Swift.

Common round houses from the Terai up to the Central Valley. Breeding birds were collected in April and May. A nestling almost ready to fly was taken out of one of the nests suspended below the eaves of the Government Rest House at Bhimpedi May 5th.

Hirund-apus caudacutus: White-throated Spinetail.

A flock of these large impressive swifts flew over our camp in the early morning on a ridge above Dhankuta at 6,000 ft. The species was not seen within collecting range again, thus proving that a bird collector must needs shave with shotgun in hand.

ALCEDINIDAE

Ceryle lugubris, the Himalayan Pied Kingfisher, was seen in the west Nepal Terai along the feeder streams of the Karnali, and **Ceryle rudis** the Indian Pied Kingfisher also was seen into the 'duns' along the big rivers in the west and east.

Alcedo atthis bengalensis Gmelin : Common Indian Kingfisher.

Found along the principal rivers at all seasons, the Common Indian Kingfisher was none too easy to collect as it normally frequented the open watercourses and perched well out in the centre of the streams on boulders.

Halcyon smyrnensis fusca Boddaert : White-breasted Kingfisher.

We found the White-breasted Kingfisher all the way from the Terai to the Valley where a male in breeding condition was collected on Naggerjung at 6,000 ft. in April. The behavior of this bird and its presumed mate, made me suspect that the pair was breeding high up on Naggerjung in a patch of sandy soil covered with *Pinus longifolia,* far from water, but I was unable to locate a nest in the various sandy banks.

MEROPIDAE

Merops orientalis orientalis Latham : Common Indian Bee-eater.

Specimens were collected at all seasons in the open-country Terai near the Indian border. *Merops leschenaulti* was also seen.

Nyctiornis athertoni athertoni (Jardine & Selby) : Blue-bearded Bee-eater.

A male from Chatra records our only encounter with the species. Wing 137. Soft parts: iris yellowish-green; bill basally gray, distally black; legs greenish-yellow.

CORACIIDAE

Coracias benghalensis benghalensis Linnaeus : Indian Roller.

Common from one end of the Terai to the other in open areas. Breeding specimens were taken in January and March. Western birds in our series are certainly paler in a continuous cline than topotypes from Bengal. In a zone to the east of Nepal, from Darjeeling south to the Calcutta area, hybrids between this race and *affinis* may be taken. I have seen such hybrids from the Sikkim Duars, Dacca and

Chandpara, a few miles east of Calcutta. In color these birds favor *benghalensis,* but are darker, lacking the chestnut nape ring, and on the back resembling *affinis*.

UPUPIDAE

Upupa epops epops Linnaeus: Hoopoe.

I prefer to use the typical name for the migrants which we found in the Terai in December and January. The species was rather common on open paddy and grazing land.

Upupa epops orientalis Baker : Northern Indian Hoopoe.

The resident Hoopoe in Nepal appears to be this race. I cannot agree with Whistler and Kinnear (1935 p. 28) that *orientalis* is not worthy of recognition. These birds are paler than Mysore specimens of *ceylonensis* although the measurements are about the same, wing up to 145, but darker and smaller than the typical race.

BUCEROTIDAE

Tockus birostris: Gray Hornbill.

Common in the Terai and 'duns' in large trees, often near villages and cultivation. A female was taken at Kauriala Ghat. None of the large hornbills were seen in Nepal much to our disappointment.

CAPITONIDAE

Megalaima virens marshallorum (Swinhoe) : Great Himalayan Barbet.

Unfortunately no specimens of this Barbet were taken in western Nepal, although it was heard calling numerous times above Rekcha. Birds from the Central Valley belong to this race but are somewhat intermediate between it and the following subspecies both in color and size. Particularly is this so with one male which is smaller and brighter than the others in the series. Three males and two females were secured on Naggerjung. They measure: wing ♂ 141.5-148, ♀ 145, 146. In April these birds were coming into breeding condition.

Megalaima virens magnifica Baker : Assam Great Barbet.

Two males were collected at Tinjuré, which definitely belong to this eastern subspecies. They were shy, and the species was not easy to approach. One bird was being molested by an Indian Sparrow Hawk when secured. Wing: 145, 146.

Megalaima zeylanica caniceps (Franklin): Northern Green Barbet.

A female coming into breeding condition was taken at Tikapur on January 8. This bird is indistinguishable in size from South Indian examples, so that it seems unwise to recognise *kangrae* (Whistler and Kinnear). In their original description (l.c. 1934, p. 516), the authors give a convincing series of measurements indicating that *kangrae* is a well-marked size race, (wing 121.5-129.5 as against 112-117.5 for

S. Indian birds), but in the Hyderabad Survey (1934, p. 126) Whistler notes that intermediates from Hyderabad in his collection measure 121.5-125.5. A pair in my collection from Mysore measure: ♂ 121, ♀ 120. All these measurements indicate too much overlap to make the race tenable. This Nepal female has a wing measurement of 125. There is no plumage difference.

Megalaima zeylanica rana Ripley : Western Lineated Barbet.

As I have pointed out in the original description (1950), this Barbet is a member of the *lineata* subgroup within the species *zeylanica*, the subgroup characterized by having the space between the eye and the bill feathered. I collected this form, which is larger and darker than *hodgsoni*, in the 'duns' near Bajora in western Nepal where it had previously been unknown, while twenty miles to the south in the Terai proper, we found *caniceps*, one of the naked-cheeked forms. Thus, *rana*, is a foothill bird which replaces *caniceps*.

Megalaima zeylanica hodgsoni Bonaparte : Eastern Lineated Barbet.

In my description of *rana* (l.c., 1950, p. 101) I restricted the type locality of *hodgsoni* to Simra in the central Nepal Terai. In central Nepal this subspecies occurs as high as the Valley, but is more commonly a Terai bird, while it seems to be almost entirely a Terai species in eastern Nepal where it replaces *caniceps*, the Terai and lowland species of the western part of the country. Farther east again it is primarily a lowland bird in Sikkim and Assam.

Megalaima asiatica asiatica (Latham) : Blue-throated Barbet.

Birds were taken throughout Nepal from 950-6,000 ft. Breeding specimens were collected in March and April. Birds from the western part of the range seem to be very slightly larger in size, but are otherwise indistinguishable.

Megalaima haemacephala indica (Latham): Crimson-breasted Barbet.

The little Coppersmith was taken at Katmandu and in eastern Nepal from the Terai up to almost 4,400 ft. Birds were breeding in March and April. This species was only seen in large fig and banyan trees near cultivation or settlement.

INDICATORIDAE

The open rock faces on the ridges above Dhankuta leading towards Mangalbaré were covered with the marks of old hives of wild bees, but no active hives were observed at the time we were in the area. Undoubtedly, however, it is a suitable place for the Honey Guide to occur, and local people spoke of such a bird being in the area during the monsoon season.

PICIDAE

Picumnus innominatus innominatus Burton : Eastern Himalayan Speckled Piculet.

The Piculet was found by us only in the Central Valley and at Bhimpedi, although I saw a single bird at Chisapani. However, failing to collect any I have been unable to determine the race of western Nepal. Birds were breeding in April-May. Wing ♂ 57, ♀ 59.

Picus xanthopygaeus (Gray and Gray) : Scaly-bellied Woodpecker.

A female of this species with a wing of 134.5 was taken at Chisapani in low scrub (*Acacia catechu*) on a sandy island below the gorge where the Karnali River emerges from the foothills. The bird was calling, a loud complaining single-syllable note.

Picus canus sanguiniceps Baker : Black-naped Woodpecker.

Four males and two females from western Nepal belong to this western form. The birds measure; wing ♂ 152-156, ♀ 153, 157. Soft parts: iris reddish-brown, red; bill blackish-gray, base of lower mandible gray; legs bluish-gray. These birds were taken from 950-2.000 ft., in the 'duns' primarily, in rather thick secondary forest, or in clearings in primary forest, where considerable tangles of sub-stage growth and low trees and vines had resulted from the opening in the higher trees.

Picus canus sanguiniceps $\gtrless$ gyldenstolpei

In the Central Valley we found the Black-naped Woodpecker common in the forested areas at Godaveri, Naggerjung and Gokarna where its loud tapping and soft calls, at times not unlike the American Flicker (*Colaptes*) are very noticeable. These specimens have a tendency to the yellowish-golden wash which characterizes the eastern race and seem exactly intermediate. Wing ♂ 146-150, ♀ 150. One specimen, taken in April, is extremely worn with most of the greenish wash off the lower plumage, and the red crest very pale. Breeding males were taken in April also.

Picus canus gyldenstolpei Baker : Assam Black-naped Woodpecker.

Specimens of this eastern subspecies were secured on the Kosi drainage system from 500-3,500 ft. A pair measure: wing ♂ 144, ♀ 148.5. These birds are definitely smaller than *sanguiniceps,* in addition to being more yellowish-golden in color.

Picus flavinucha flavinucha Gould : Eastern Himalayan Greater Yellow-naped Woodpecker.

The Greater Yellow-naped Woodpecker was a conspicuous part of the scene in wooded areas in the Central Valley, particularly on Naggerjung where breeding birds were collected in April. The species was common also in the forest around Chatra and up into the 'duns' wherever there were any remnants of deciduous or evergreen woods left. Their squeaking calls were a feature of the foothill forest above Chatra, although the birds were not yet in breeding condition in February. Unfortunately these Yellow-naped Woodpeckers were seen in western Nepal in the area at the foot of the hills near Chisapani, but not collected.

Picus chlorolophus simlae Meinertzhagen : Western Himalayan Smaller Yellow-naped Woodpecker.

This is a poorly characterized race indeed. The difference in the color of the nuchal crest follows a continuous cline, and is almost indistinguishable at best. There is a size difference, and it might be as well to characterize this race by saying that specimens of it have a wing measurement of 140 and over. Within this race I would include birds from central Nepal, where we took specimens at Godavari and Gokarna. A male coming into breeding condition was collected April 22.

Picus chlorolophus chlorolophus Vieillot : Eastern Himalayan Smaller Yellow-naped Woodpecker.

Specimens of the eastern race were collected at Chatra. They measure; wing 132-133.5.

Dinopium benghalense benghalense (Linnaeus) : Golden-backed Woodpecker.

Common in wooded parts of the Terai.

Dinopium shorii shorii (Vigors) : Golden-backed Three-toed Woodpecker.

A bird of the large Terai forest. Found in the same localities as the Golden-backed, but it shows less tolerance for changing conditions, and seems to be more specifically adapted to primary forest, both deciduous and evergreen.

Mulleripicus pulverulentus mohun Ripley : Indian Great Slaty Woodpecker.

The Great Slaty Woodpecker seems to be a bird of 'sal' and evergreen forest in its primary condition. I have only found it in undisturbed areas which may account for its rarity. Like the Ivory-bill (*Campephilus*) in the New World, it may be a species whose existence is contingent on large stands of original forest, although from Baker's account (1927, p. 87), it sounds more tolerant of a variety of conditions. Soft parts: iris brown; bill, upper mandible dark horn, lower light horn, tip black. The forehead of our one specimen was glued with tree sap.

Dendrocopos darjellensis darjellensis (Blyth) : Darjeeling Pied Woodpecker.

A series was taken at Mangalbaré in tree-rhododendrons. The birds made a great variety of taps and occasional squeaking, woodpecker calls. Soft parts: iris reddish-brown; bill, upper mandible grayish-black, lower pearl-gray; legs dark greenish-gray. Wing ♂ 129-131, ♀ 124-132. This was the only woodpecker of the higher altitudes in east Nepal.

Dendrocopos cathparius cathparius (Blyth) : Himalayan Lesser Pied Woodpecker.

A single male taken at Chitlang in April is our only record for this species. Wing 105.5, tail 63, culmen 18.5.

Dendrocopos hyperythrus hyperythrus (Vigors): Rufous-bellied Woodpecker.

Rufous-bellied Woodpeckers were collected on the Chandragiri Pass and at Mangalbaré. Soft parts: iris reddish-brown; bill, upper mandible black, lower greenish-yellow; legs blackish-gray.

Dendrocopos auriceps (Vigors): Brown-fronted Pied Woodpecker.

Found in a characteristic biotope, open scrub oaks cut over, and mixed with low secondary growth. This is a fearless bird, observed nesting in a dead stub 20 ft. high on the main Katmandu trail beyond Sisagarhi in early May. Other specimens in breeding condition were collected in April. One male has a stained breast, the color blackish as if with fruit juice. Soft parts: iris brown; bill slaty-gray; legs greenish-gray. Taken from 5-6000 ft. Wing ♂ 114, 116-5, ♀ 105-109.

Dendrocopos macei macei (Vieillot): Fulvous-breasted Pied Woodpecker.

Birds were taken at all altitudes from the Terai to 5,300 ft. A male from Godaveri is coming into breeding condition in April. Soft parts: iris brown; bill, upper mandible black, lower gray; legs greenish-black.

Dendrocopos mahrattensis mahrattensis (Latham): Yellow-fronted Pied Woodpecker.

This lowland woodpecker was collected in the Terai in light forest. Soft parts: iris ♂ red, brown, ♀ brown; bill black-gray, black along the culmen; legs grayish-brown.

I have never felt that the race *aurocristatus* was worth separating, having examined a considerable series from all over India.

Dendrocopos canicapillus mitchellii (Malherbe): Nepal Pigmy Woodpecker.

The pigmy woodpecker was found from the Terai nearly to 5,000 ft. Males and females were in breeding condition at Chatra in late February, while a female taken at 4,700 ft. in April showed no signs of breeding. Baker (1934, p. 295) notes that April and May seem to be the breeding season in Kumaon. Soft parts: iris brown, whitish-brown; bill blackish, base of lower mandible gray; legs blackish-brown.

A series from Nepal measure: wing ♂ 83.5-86 (Kosi R.), 90, 91 (W. Nepal), ♀ 85-89. There seems to be a slight tendency to larger size in W. Nepal birds, as well as this western population having wider bands on the back, showing more white.

Dendrocopos moluccensis nanus (Vigor): Northern Indian Pigmy Woodpecker.

Three females of this tiny species were taken near Chisapani and Tikapur in the open acacia scrub near the rivers. They measure: wing 74.5-79. Soft parts: iris yellow, ocular area light purplish-red; bill blackish-gray; legs grayish-black.

Blythipicus pyrrhotis pyrrhotis (Hodgson): Red-eared Bay Woodpecker.

A single female making a peculiar loud *yarrup* was collected on a stump in thick second-growth at Godaveri. Soft parts: iris reddish-brown; bill greenish-yellow; legs black.

Chrysocolaptes lucidus sultaneus (Hodgson): Hodgson's Golden-backed Woodpecker.

The Golden-backed Woodpecker was met with in the original forest areas of the upper Terai and 'duns'. Hodgson (1837) originally described this fine woodpecker from Nepal. I hereby restrict the type locality to Simra, central Nepal, as the form of central and western Nepal is larger than that found in the east. A male and female from Chisapani and Solta measure: wing ♂ 181, ♀ 182.5, culmen ♂ 52.5, ♀ 50. These birds had a distinct high single note reminiscent of the American Pileated Woodpecker.

Chrysocolaptes lucidus guttacristatus (Tickell): Eastern Golden-backed Woodpecker.

The Golden-backed Woodpecker had begun to breed at Chatra in February. A male and female measure: wing ♂ 171, ♀ 171; culmen ♂ 49 ♀ 48. These birds agree in size with those from Bengal and Assam.

ALAUDIDAE

Alauda gulgula guttata Brooks: Kashmir Skylark.

This Skylark, which has previously been recorded from Nepal by Scully (op. cit. p. 367) with a question mark from Nawakot was found by us at Pharping in the Central Valley and at Rekcha in December. The birds were in small flocks in open paddy fields, and would fly up together, straight up to a certain height and then hurl all at once off horizontally in one direction, like a dust devil flung into the air and then picked up by the breeze. These were winter migrants. Wing ♂ 105, 106.

HIRUNDINIDAE

Hirundo rustica rustica Linnaeus: Common Swallow.

The Common Swallow was found in the Central Valley, flying about in areas of trees. A male in breeding condition was taken at Thankote in April.

Hirundo daurica daurica Linnaeus: Northern Striated Swallow.

A female of this darker migrant subspecies was collected December 7th on the Sisagarhi Trail at 5,000 ft. Wing 119.

Hirundo daurica nipalensis Hodgson: Nepal Striated Swallow.

The Striated Swallow was found breeding in April and May from Bhimpedi up throughout the Valley. A series measure; wing ♂ 112-118, ♀ 115-117.

Hirundo rupestris Scopoli: Crag Martin.

A single female Crag Martin was shot over Chainpur in February.

Riparia paludicola brevicaudata (Horsfield): Indian Sand Martin.

Breeding males were collected at Tikapur in January. The species was also collected at Pharping in the Valley near the Power Station where it apparently breeds in holes in the cliffs of the Bagmati River. All the specimens collected were males. Wing 93-98.

MOTACILLIDAE

Motacilla maderaspatensis Gmelin: Large Pied Wagtail.

Found by us at Pharping in December.

Motacilla cinerea caspica (Gmelin:) Eastern Gray Wagtail.

Common all over the Central Valley, and found also in open areas in the Terai in winter up to April at least.

Anthus hodgsoni yunnanensis Uchida & Kuroda: Northern Tree-pipit.

The northernmost breeding form of the three subspecies of the Tree-pipit is a very common migrant through Nepal. We collected them in trees and scrub at Godaveri, Thankote and Naggerjung in April and November, at Rekcha in December and in east Nepal from 4,000 to 8,000 ft. in January and February. These pipits travel in small flocks, walking over the leaves on the ground with soft rustling noises, and when flushed, flying up to a tree branch with a characteristic *tseep,* to perch with bobbing tail. (For measurements and key, see Ripley 1948b).

Anthus hodgsoni hodgsoni Richmond: Hodgson's Tree pipit.

This more boldly streaked bird was found by us at Mangalbare and Chitré in January and February, perching often on the tops of tall exposed trees. The birds were rather shy. Wing ♂♂ and ♀♀ 81-85.

Anthus richardi rufulus Vieillot: Indian Pipit.

A breeding species in the Valley in April. Found wintering in the Terai at Birganj in November. Wing ♂♂ and ♀♀ 76-82.

CAMPEPHAGIDAE

Pericrocotus flammeus speciosus (Latham): Himalayan Scarlet Minivet.

The large Scarlet Minivet was common in the Valley in April where it was a breeding species on Naggerjung. One of the breeding males is in first year plumage, similar to the female but more tinted with orange. We also found the minivet breeding in east Nepal at Chainpur February 10th. Wing ♂ 101.5-107, ♀ 101-103.5. The specimens have the characters assigned to the race by Deignan, (1946).

Pericrocotus ethologus laetus Mayr: Sikkim Long-tailed Minivet.

This species, formerly confused with the Short-billed Minivet (Mayr, 1940), was the only one of the two encountered by us in Nepal. I collected two females of this race climbing the hill to Chainpur at

4,200 ft. in February. A small flock was flying back and forth in a clump of *Pinus longifolia*. No males were secured. The females showed no gonadal development although chasing was going on. Wing 89, 90; tail 104, 105.

Pericrocotus ethologus favillaceus Bangs & Phillips: Western Himalayan Long-tailed Minivet.

Common on Naggerjung and at Gokarna where we found this minivet breeding in April, and apparently resident in November. We also collected it in the west Nepal Terai. Two males in first year plumage were taken in breeding condition in April.

Pericrocotus peregrinus peregrinus ≶ vividus: Small Minivet.

The Small Minivet was found only in the Terai, and not too commonly. Birds from west Nepal seem to be intermediate between *peregrinus* and *vividus*. Both males and females are brighter, more yellowish on the abdomen than typical *peregrinus*, but paler, more pure gray on the upperparts and slightly less bright yellow on the underparts than *vividus*.

Pericrocotus peregrinus vividus Baker: Burmese Small Minivet.

A single female taken at Biratnagar belongs to this eastern race.

Hemipus picatus capitalis (McClelland): Brown-backed Pied Shrike.

The little Pied Shrike was collected in the Terai and up to 5,000 ft. in west and central Nepal. Breeding birds were found in February and April in the Terai. A male from Rekcha has the brown back feathers mixed with black.

Tephrodornis pondiceriana pondiceriana (Gmelin): Common Wood-shrike.

This small Wood-shrike was common in the Terai in west and central Nepal in open secondary growth and light forest where as usual it was seen in small flocks and family parties. Wing ♂ 90-91.5, ♀ 83-87.5. Females were collected far more commonly than males.

Tephrodornis gularis pelvica (Hodgson): Nepal Wood-shrike.

The larger of these two curiously similar species was taken throughout the Terai and up to Bhimpedi. Birds were in breeding condition in February, an earlier date than usually noted for this Wood-shrike. Wing ♂ 117-123; ♀ 118, 120.

Coracina fimbriata melaschista (Hodgson): Dark Gray Cuckoo-shrike.

A common breeding species in woods in the Valley. Apparently wintering birds were also found in the east Nepal Terai. This Cuckoo-shrike seems to breed in April in Nepal, from the evidence of our specimens, while a male from the Khasia Hills taken in mid-March was in breeding condition. Does the species breed earlier in the east? Wing ♂ 120-127.

Coracina novaehollandiae nipalensis (Hodgson) Large Himalayan Cuckoo-shrike.

The large Himalayan Cuckoo-shrike was a familiar feature of the Terai forests and on in open country up to 6,000 ft. where it was breeding on Naggerjung in April. A female with large oviduct eggs was taken April 20. The loud broken tremolo whistle of this bird was often heard in the foothills from east to west. The species will apparently adapt itself to the devastated conditions of the 2-5,000 ft. level in certain areas where the soil has been destroyed and only poor scrub can exist. Wing ♂ 177.5-187.5, ♀ 177.5, 182. The breeding female is in very worn plumage but shows no sign of moult.

LANIIDAE

Lanius schach tricolor (Hodgson): Himalayan Black-headed Shrike.

The Black-headed shrike was the common breeding shrike of the Valley where we found birds with enlarged gonads at Naggerjung and Gokarna in April. The species frequented light scrubby woods in contrast to the more open country habits of its migrant neighbour from Tibet and the higher hills.

Lanius schach tricolor xerythronotus

A male and a female taken at Tikapur and Rekcha furnish the first records from west Nepal of this hybrid population found farther west in the Himalayan foothills of Kumaon and Garwhal. Both birds have irregular areas of grayish on the crown and irregular gray shading on the shoulders and nape. This 'hybrid swarm' apparently does not get as far east as central Nepal.

Lanius tephronotus tephronotus (Vigors): Gray-backed Shrike.

Collected in open scrub at Gokarna in April and at Chatra in February.

Lanius cristatus cristatus Linnaeus: Brown Shrike.

A common winter visitor to the Terai where it was taken by us in open areas, especially on telephone wires in November, January, February and March.

ARTAMIDAE

Artamus fuscus, the Ashy Swallow-shrike, was seen commonly in the Terai in open areas, and up to Bhimpedi, but no specimens were collected.

AEGITHINIDAE

Aegithina tiphia tiphia (Linnaeus): Iora.

The Iora was common in the Terai, almost always in bushes near streams. There is a typical facies near the banks of the big streams where flooding has created a zone of scrub which grows over the gravel and rocks washed down each season. Here we found the birds during the winter months, not singing. Nepal birds seem slightly paler above and below than topotypes from Bengal in fresh plumage. No specimens were in breeding condition, although Bengal birds with enlarged gonads were taken in January, and Assam specimens in March.

Chloropsis hardwickii hardwickii Jardine & Selby: Orange-bellied Chloropsis.

Common in second growth in the Central Valley from 5-6,000 ft. A bird also of the ridges in the light forest that now remains. A male coming into breeding condition was taken in April. Breeding birds in Assam were taken in mid-March, a month earlier. A Nepal series measure: wing ♂ 93-95. This mid-montane zone species was not seen in east Nepal.

Chloropsis aurifrons aurifrons Temminck: Gold-fronted Chloropsis.

The Gold-fronted Chloropsis was found by us in the upper Terai forest adjacent to the foothills and into the 'duns'. The species was found in thick forest only, invariably near flowering trees. Birds were in breeding condition at Chatra in late February.

PYCNONOTIDAE

Pycnonotus flaviventris flaviventris (Tickell): Black-crested Yellow Bulbul.

In my paper on Ceylon birds (1946) I have already stated my reluctance to place the distinctive S. Indian and Ceylon bulbuls, *gularis* and *melanicterus* in with *dispar* and *flaviventris* contra Delacour (1943). I feel that the crested black-throated bird of the sub-Himalayas can well stand alone, separate from the crestless ruby-throated species from which it is widely separated geographically as well.

These crested bulbuls were found by us in the wooded parts of the Terai close to the foothills. A breeding male was taken at Chatra February 18. A single male from the Khasia Hills seems more bronzy-olive and darker on the breast than Nepal males.

Pycnonotus leucogenys leucogenys (Gray): White-cheeked Bulbul.

A common species from the Terai to 6,000 ft., feeding in the open scrub on berries and seeds and hunting in large flocks in the winter season. Breeding birds were taken in April and May in the Valley and down to Bhimpedi. These spring birds were in very worn plumage but the moult had not yet commenced.

Pycnonotus cafer pygaeus (Hodgson): Eastern Indian Red-vented Bulbul.

There is a slight cline in color in this species from west to east in Nepal, western birds approaching *intermedius* in color. However, they do not agree with that form in size. A series measure: wing ♂♂ 96-106, culmen 17-19.5. A specimen was breeding April 8 at Thankote. Another male from this village had a single white feather in the crown.

It is worth noting that, following Deignan's recent revision of this species (1949), birds from the Mishmi Hills agree with *primrosei* rather than *pygaeus* in the color of the ear coverts.

Alcurus striatus striatus (Blyth): Striated Green Bulbul.

Uncommon in Nepal. Collected only round Chandragiri Pass and at Chitré in the zone of oaks and rhododendrons at 7,500 ft.

Microscelis mcclellandi mcclellandi (Horsfield): Rufous-bellied Bulbul.

A rather shy bulbul, not easy to approach either in scrub or in tall trees, both of which it seems to favour at different seasons. Breeding males were taken in thick secondary scrub in mid-April at Thankote and Naggerjung. A single male from Rekcha, one of the only two birds of this species seen there, has a slightly suffused, less well-defined white throat patch, streaked with fuscous.

Microscelis flavala flavala (Hodgson) : Himalayan Brown-eared Bulbul.

A pair of this pretty bulbul were taken at Bhimpedi in May. The birds were breeding. They measure; wing ♂ 100, ♀ 97; tail ♂ 93, ♀ 87; culmen 19 (both). Assam and Burma specimens tend to be somewhat darker, especially on the lower surface.

Microscelis madagascariensis psaroides (Vigors) : Black Bulbul.

The Himalayan Black Bulbul was common in central and eastern Nepal but was not seen in the western part. Birds were breeding in April and May. In the Mangalbaré area the species seemed scarce and was definitely shy. These birds measure wing ♂ 120-29, ♀ 114-123.5; tail ♂ 102-114, ♀ 93-107; culmen ♂ 25-27, 23.5-26.

If Mishmi Hills birds are compared with fresh fall and winter-plumaged *psaroides,* it may be observed that they are intermediate between *psaroides* and *nigrescens,* darker than the former, but lighter than the latter. They also tend to be larger than typical *psaroides.*

CINCLIDAE

Cinclus pallasii tenuirostris Bonaparte : Brown Dipper.

The only specimens of the Brown Dipper collected were taken at Kulikhani at 4,750 ft. in the Markhu Valley on the trail into Katmandu. The species was also seen at similar elevations in eastern Nepal on small feeders of the Kosi River system. A male with slightly enlarged gonads was taken in November. The wing of this specimen measures 98.

TROGLODYTIDAE

Troglodytes troglodytes nipalensis Blyth : Nepal Wren.

A good series of the little wren were taken from Dur on up to Mangalbaré at altitudes ranging from 8,500-10,000 ft. The species was not otherwise seen. Smythies (l.c.p. 441) reports these wrens from the Gandak-Kosi watershed north of the Valley. The birds were seen only on the bare grassy Alpine meadows and not in the forest. Their little *tzit, tzzit* call was often heard, but the birds were seldom seen, as they crept about in the grass and low plants close to the ground. These birds come within the measurements given by Kinnear (1944).

MUSCICAPIDAE

Subfamily TURDINAE

Cochoa purpurea : Purple Thrush.

A bird, presumably of this species was flushed out of a damp thicket at Bhimpedi in May.

Enicurus immaculatus Hodgson : Black-backed Forktail.

This species is found in the foothills from one to four thousand feet. Forktails were observed on or near small streams within the Siwalik range, and along the 'duns', frequenting overgrown thickets and masses of bracken or other fern. A male taken near Kune Ghat on the Karnali has a wing measurement of 93.5.

Erithacus cyanurus pallidiora (Baker) : Kashmir Bush Robin[1].

A single female taken at Rekcha December 29 is pale and seems to belong to this race. If so, it is a first record for Nepal. Wing 76.

Erithacus cyanurus rufilatus (Hodgson) : Red-flanked Bush Robin.

A male and female of this darker race were collected at Mangalbaré in February and measure; wing ♂ 87, ♀ 82.

Erithacus indicus indicus (Vieillot) : White-browed Bush Robin.

A pair were taken at Mangalbaré in February.

Erithacus calliope calliope (Pallas) : Ruby-throat.

Found in February in east Nepal at 1,200 ft. along the Arun Kosi.

Erithacus brunnea (Hodgson) : Indian Blue Chat.

The Blue Chat was common at Gokarna and Chandragiri in March and April. A male, April 2, was in breeding condition and singing lustily in a dense thicket near the main trail into the Valley. Soft parts: iris dark brown; bill black; legs brownish-flesh, or, grayish-flesh.

Erithacus leucura (Hodgson) : White-tailed Bush Robin.

A male was taken at Chitlang in forest at 6,500 ft. in April.

Phoenicurus frontalis (Vigors) : Blue-fronted Redstart.

Non-breeding birds were very common around Mangalbaré above 8,000 ft., and in the Valley above 6,000 ft. in November. Where present the species was ubiquitous in clearings, scrub pasture, or open areas near small streams. Its single note, a sort of *tik* or *click* was often the only sound in these quiet Alpine meadows.

Phoenicurus schisticeps (Gray) : White-throated Redstart.

A single female was collected out of a flock wandering over open meadows and light scrub at Mangalbaré, February 1. Wing 81.5.

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[1] For notes on the genera of the Thrushes see Ripley. (Mss)

Phoenicurus fuliginosus fuliginosus (Vigors) : Plumbeous Redstart.

Common along the upper Bagmati and other streams in the Central Valley where rapids and boulders occur. Found also along the Kosi in similar situations from 1,000-5,000 ft. Immature birds were collected at Sundarijal in May.

Phoenicurus leucocephalus (Vigors) : White-capped Redstart.

Seen and collected along all the big rivers between 1,000-4,500 ft. As in the case of the Plumbeous Redstart, this species prefers falling water and rapids.

Saxicola caprata bicolor Sykes : Northern Indian Stone-chat.

The Indian Stone-chat occurs in the Terai areas immediately adjacent to the Indian border. Specimens were taken at Kauriala Ghat.

Saxicola torquata indica Blyth ; Indian Bush-chat.

Breeding Bush-chats were collected at Gokarna in April, the earliest date being the 19th. An exceptional male, taken February 8 in east Nepal is recorded as in breeding condition. A juvenal bird was taken in April in Gokarna, so that it may be that these birds begin breeding as early as February.

These were active chats, in light scrub and weeds at the edges of meadows and pasture land. They perch characteristically on a bush in the centre of a grassy clear space, and fly out to hawk after insects, returning to the same perch.

Saxicola torquata przewalskii (Pleske) : Turkestan Bush-chat.

A pair were collected at Pharping in December on open dry paddy land. The back of the female is enough paler than that of the Indian race to serve as a field character.

Saxicola ferrea ferrea G. R. Gray : Dark Gray Bush-chat.

A male was taken at Chisapani April 30. Wing 68.

Saxicoloides fulicata cambaiensis (Latham) Black-backed Indian Robin-chat.

Common in the Terai in similar situations to those in India proper. Eastern Nepal specimens, which were not examined, may belong to *stuart-bakeri.*

Prunella immaculata (Hodgson) : Maroon-backed Accentor.

Small flocks of these birds were common at Mangalbaré in low rhododendrons, on the edges of clearings or on the ground in the open. The birds were shy and difficult to approach. Three females measure; wing 78-81; tail 49.5-57; culmen 12.5-13. Soft parts: iris orange with white inner ring; bill black legs pale brownish-flesh.

Prunella strophiata strophiata (Blyth) : Rufous-breasted Accentor.

A male and female were taken at 4,300 and 8,750 ft. in east Nepal. They measure: wing ♂ 71, ♀ 66. Soft parts: iris brown; bill brownish-black; legs brownish-flesh. This Accentor was found in the open on scrubby meadow land.

Copsychus saularis saularis (Linnaeus): Magpie-robin.

Found from the lowlands up to the Katmandu Valley wherever cultivation and villages occurred. Breeding specimens were taken in April.

Copsychus malabaricus indicus Baker: Eastern Shama.

The Shama was common in the Terai forest in central and eastern Nepal and was not found in the west. These birds are basically intermediate between *indicus* and *malabaricus,* although closer to the former with which subspecies I have included them. In color males are slightly paler, females definitely paler on the lower surface than *malabaricus,* and females are slightly lighter in color on the upper surface also. Males from Nepal, Sikkim and the U.P. are slightly darker on the lower surface than Assam birds, but the population is an intermediate one, implying a continuous cline in this character. The measurements of a number of specimens follows:

	Wing		Tail			Culmen	
S. and Western India ...	10 ♂♂ 94–99	(96·2)	27	160–207	(180·9)	8	16·5–18
	4 ♀♀ 87–90	(88·3)	9	113–136·5	(125·1)	3	16·5–17
E. Ghats, M.P., Nepal, U. P., Sikkim ...	4 ♂♂ 91–98·5	(94·8)	11	133–159	(147·1)	4	17–18
	4 ♀♀ 84–90	(87·7)	5	110–126	(118·4)	3	17–(3)
Bhutan Duars, Assam, Burma.	6 ♂♂ 91–96	(94)	17	112–148	(135·6)	6	16–19
	3 ♀♀ 90–91		6	102–124	(111·5)	3	17–18

The above measurements indicate again a cline in size, but the differences are not great enough to make it necessary to designate an intermediate population. The suggestion has been made that the short-tailed eastern birds were all collected in winter, making the tail length a seasonal character, but enough specimens have been taken at other seasons to disprove this assumption. Presumably the short-tailed examples are young or moulting birds. From the above evidence I would list the ranges of the two races as follows:

(a) *Copsychus malabaricus malabaricus*

Western Ghats south through Mysore, Malabar and Travancore in evergreen and moist deciduous biotope.

(b) *Copsychus malabaricus indicus.*

From the Bhutan Duars, Assam and western Burma west along the foothills to central Nepal, south through the U.P. and Bihar to the eastern Madhya Pradesh (= Central Provinces), and in Orissa to northern Madras in the Eastern Ghats wherever suitable evergreen and moist deciduous forest exists.

Monticola rufiventris (Jardine & Selby): Chestnut-bellied Rock thrush.

A male was collected at Chisapani April 27, on the trail to the Central Valley.

Monticola cinclorhyncha (Vigors): Blue-headed Rock-thrush.

Breeding specimens were taken at Bhimpedi and Naggerjung in April and May. Soft parts: iris brown; bill black; legs grayish-brown.

Monticola solitarius pandoo (Sykes): Indian Blue Rock-thrush.

A single immature male was taken in the Terai in February. It is not uncommon in open areas during the winter.

Zoothera dauma dauma (Latham): Small-billed Mountain Thrush.

A juvenal male was collected on Naggerjung in late November, and a male coming into breeding condition was taken at Godaveri in late April. This species was found between the Terai at the base of the hills, and 6,000 ft. in the winter, and above 4,500 ft. in April and May. It is a quiet bird of the heavy forest or on forest edges in well-grown bushy cow pastures near streams. There is considerable individual variation, some specimens being more heavily banded with black than others, particularly on the head.

Zoothera dixoni (Seebohm): Long-tailed Plain-backed Mountain Thrush.

A single male of this obscure species was taken at Mangalbaré in deep jungle in February. Soft parts: iris brown; bill dark brown, base of lower mandible pale; legs flesh.

Zoothera citrina citrina (Latham): Orange-headed Ground Thrush.

The Orange-headed Ground Thrush was found breeding at Gokarna in May. I found a nest with the bird sitting in the first week of May. The nest was placed about eight feet up in the crotch of a sapling growing in a gully in thick woods. The situation allowed one to look in easily from the bank. The bird was very shy, and flushed when I was still some distance away. The species was not observed during the winter in the Terai. This is certainly one of the commonest of the thrushes in the Valley, and with the Gray-winged Blackbird, is commonly kept as a pet by the Newars.

Turdus rubrocanus rubrocanus Gray: Gray-headed Thrush.

One flock was seen at Mangalbaré, but unfortunately no specimens were taken.

Turdus boulboul (Latham): Gray-winged Blackbird.

Found in the Terai on the edge of the hills in February, and on up to 6,000 ft. in April and May. Breeding males were collected on Chandragiri Pass and at Gokarna.

Turdus ruficollis Pallas: Red-throated Thrush.

Specimens were taken on Naggerjung in April. They were silent and shy, sitting quietly in low fruiting bushes. Soft parts: iris dark brown; bill, upper mandible black, lower basally dark yellow, distally black; legs brownish-yellow (♂), grayish-brown (♀).

Turdus unicolor Tickell : Tickell's Thrush.

Found in the winter in the Terai and up to 4,700 ft. in April in central Nepal.

Myiophoneus caeruleus temmincki Vigors : Himalayan Whistling-thrush.

Whistling-thrushes were collected in winter from 900 ft. up, and breeding males were found in the Valley in April and May. A male had the bill and feet covered with cow dung, evidently in quest of larvae. There seems to be a cline in size in the Nepal populations, birds from the west averaging larger. One male from Rekcha has a wing of 192, much larger than any measurement given by Delacour for the race (1942).

Subfamily TIMALIINAE

Pellorneum ruficeps mandellii Blanford : Nepal Spotted Babbler.

All specimens taken in west, central and eastern Nepal prove to belong to this race. The Spotted Babbler was found in the 'duns' in winter and in the Terai foothills at 1,000-2,000 ft., while in April it was found higher, well into the hills to 4,500 ft. However, in the Valley it seems to be a year round resident in such places as Naggerjung. Breeding birds were taken in March and mid-April.

Malacocincla sepiaria abbotti Blyth : Abbot's Babbler.

This distinctive babbler was found only in the Terai at Chatra where it occurred in dense scrub patches in original forest. It was quiet and fairly shy. Soft parts: iris reddish-brown, light reddish-brown; bill upper mandible black, lower gray; legs brownish flesh. Wing ♀ 77, 80; tail 47.5, 51; culmen 20, 21.5.

Pomatorhinus montanus schisticeps Hodgson: Slaty-headed Scimitar Babbler.

A pair taken at Rekcha measure: wing ♂ 106, ♀ 97.5. Soft parts: iris yellow; bill yellow, base of maxilla black; legs ♂ grayish-brown, ♀ bluish-slate. It is interesting to note that in a female of *cryptanthus* taken at Nongpoh, Khasia Hills, Assam, in March 1949, the iris is given as orange-yellow and the legs dark slate, and in two males of *sálimalii* the iris is pale red and the legs brown, and feet gray. Apparently the color of the soft parts have racial value, and males also tend to have rather more brownish legs than females, as the above color notes were all made by Migdalski and myself.

Pomatorhinus ruficollis ruficollis Hodgson : Rufous-necked Scimitar Babbler.

This shy little Scimitar Babbler was collected both in western and central Nepal. We found it from 5,000-9,000 ft. Birds were in breeding condition in mid-April. Soft parts: iris ♂ red, ♀ reddish-brown, pale brown; bill, upper mandible black, distal end of tomium light horn to yellow, lower mandible yellowish-white, yellow; legs brown, feet slate, pads dull yellow. Wing ♂ 82.5 (2), ♀ 75-78.5. I cannot include this species in *montanus* as Delacour does (1947), when both breed throughout the same area.

Pomatorhinus ruficollis godwini Kinnear : Godwin's Rufous-necked Scimitar Babbler.

At Mangalbaré we secured a single female in dense rhododendron thickets at nearly 9,000 ft. Soft parts: iris reddish-brown; bill yellow, 2/3 of the culmen and base of the maxilla black; legs brown, feet slate.

Kinnear (1944) named this race from Bhutan. The Mangalbaré specimen is in fresh plumage as are my central and west Nepal birds, and is so much darker, more olive below, and darker, more chestnut above, that it stands out at once. Presumably fresh Sikkim skins would also agree with this specimen and those from Bhutan and S.E. Tibet, rather than Nepal birds as Kinnear states (l.c. p. 79). In this I believe that he has made a mistake, as he quotes Godwin-Austen as saying that Dafla birds are similar to those of Darjeeling rather than Nepal. The range of *godwini* should thus be; Eastern Nepal, east of the Arun Kosi River, Sikkim, Bhutan, S.E. Tibet and Dafla Hills.

This specimen measures: wing 80.5, tail 84, culmen 23, hind claw 13.

Pomatorhinus erythrogenys ferrugilatus Hodgson ; Hodgson's Rusty-cheeked Scimitar Babbler.

A large series of the Rusty-cheeked Scimitar Babbler from western and central Nepal serves to show that the bird figured by Gould (1832), represents in fact the west Himalayan population with a clear white throat. Therefore, it is better in this case to follow Ticehurst and Whistler (1924) in rerestricting the type locality for typical *erythrogenys* to the Simla-Almora area.

Compared to Sikkim and Darjeeling birds, *haringtoni* Baker, the Nepal population is much paler, less saturated on the throat. Sikkim birds are very dark gray on the throat without the distinctive dark spots on the breast. They are also darker above and on the flanks. Compared with Kulu birds, those from Nepal are darker above and somewhat grayish on the throat, and the spots on the breast are darker. West Nepal specimens are slightly intermediate, but are dark enough on the throat to be included with the central Nepal population. Thirteen males measure: wing 95-100.5 (97.8); tail 96-108 (101.5); culmen 32.5-36 (35.7).

Birds in very worn plumage were taken in early May. Breeding males and females were collected in mid-April. May birds were not in breeding condition. This scimitar babbler is a rather bold bird, the most noticeable babbler in Nepal, really, with a great variety of harsh loud calls. We found it from 3,800-6,000 ft. in secondary scrub often on the edge of cultivation.

Pnoepyga albiventer pallidior Kinnear: Western Scaly-breasted Wren-Babbler.

A single male of the Scaly-breasted Wren-Babbler was shot at Chisapani in western Nepal. It came out from some loose rocks under my feet as I stood in light mixed evergreen and deciduous forest not far from the Karnali River bank. Soft parts: bill blackish-brown, base of lower mandible whitish; legs pale brown. Wing 60, tail 14. This specimen belongs to the paler western race, while central Nepal birds are *albiventer*. The bird lacks the fulvous subterminal spots on the upper surface.

Stachyris pyrrhops Blyth : Red-billed Babbler

This is the most uniquitous babbler in the Valley. Birds were taken at all seasons from the edge of the Terai up to 6,000 ft. Breeding specimens were taken from 3,800 ft. up in April and May. In the spring the flocks seem reduced, but small parties still hunt together. A series from central Nepal measure: wing ♂ 53-56 (54.4), ♀ 50.5-52 5 (51.5); tail ♂ 50-52.5 (51.5), ♀ 45-51.5 (48.5); culmen ♂ 13-15 (14.1), ♀ 13-14 (13.4). Thus there is dimorphism in size if not in color in this species.

Birds from western Nepal and the western Himalayas seem slightly smaller, wing ♂♂ and ♀♀ 49.5-53 (51.9), as against 50.5-56 (53.3), but there is too much overlap to make the difference significant. This is interesting, however, as a reversal of the usual size cline.

Stachyris nigriceps nigriceps Hodgson : Black-throated Babbler.

A mid-montane zone babbler found from 3,800-6,000 ft. in the central area from Bhimpedi up to Godaveri. It calls with a rather pretty though mournful descending trill. Soft parts: iris dull brownish-white, dull whitish yellow (May); yellow (November); bill, upper mandible dark brown, black, lower whitish, fleshy-white; legs dull yellow, dull greenish-yellow. Wing ♂ 55-58. Males and females were in breeding condition at Bhimpedi in May.

Dumetia hyperythra hyperythra (Franklin) : Rufous-bellied Babbler.

A common species in the western Terai at Tikapur and Chisapani, frequenting bushes and grassy scrub on the edge of jungle. This species in its behavior, habits and appearance seems very close indeed to *Stachyris*. A series of both sexes measure: wing 53.5-58; tail 57-62.

Macronus gularis rubricapilla (Tickell) : Yellow-breasted Babbler.

The Yellow-breasted Babbler proved to be the commonest babbler of the eastern Terai and 'duns'. We found it in thick scrub and light second growth evergreen forest at Chatra and Muhlghat. Birds were coming into breeding condition in late February. This babbler has not previously been recorded from Nepal.

Wing, males and females, 52-59. Soft parts: iris whitish, yellow; bill slate; legs pale brown.

Timalia pileata bengalensis Godwin-Austen : Bengal Red-capped Babbler.

We found the Red-capped Babbler only at Tikapur in the thick acacia and 'jhaveri' (*Zizyphus*) scrub on small islands in the dry river beds. The birds were restless and shy, giving themselves away only by their bright sharp calls. All specimens collected were females. Wing 56-60.5; culmen 15-17.

Chrysomma sinense sinense (Gmelin): Yellow-eyed Babbler.

A male and two females from Tikapur measure: wing ♂ 68, ♀ 62, 64.5; tail ♂ 93, ♀ 85, 94.5; culmen ♂ 12.5, ♀ 12 (2). Soft parts: iris yellowish, ocular skin yellow; bill black; legs yellow. The Yellow-eyed Babbler was not as common as the Red-capped and other lowland babbler species of the western Terai.

Paradoxornis unicolor unicolor (Hodgson): Plain-colored Parrotbill.

A single male was secured out of a small flock in mixed bamboos and firs (*Abies*) at 9,400 ft. on Tinjuré ridge February 1. This species has not been recorded from Nepal since Hodgson's time. Wing 92, tail (worn) 99, culmen 15.

Paradoxornis poliotis humei (Sharpe): Black-fronted Suthora.

A single female was taken from a flock streaming through a group of thin long bamboos and rhododendrons at Mangalbaré. It agrees perfectly with Sikkim examples. Wing 46, tail 51, culmen 7. The species has not previously been recorded from as far west as this locality in Nepal.

Turdoides earlii (Blyth): Striated Babbler.

Found in high grass and thick acacia scrub in the western Terai at Tikapur. Soft parts: iris yellow; bill brownish-horn; legs pale grayish-brown.

Turdoides somervillei terricolor (Blyth): Seven Sisters or Jungle Babbler.

Specimens were taken in open cultivated country in the Terai in the western and central areas. A November male is noted as in breeding condition. Birds in very worn plumage were taken in late May.

Acanthoptila nipalensis (Hodgson): Spiny Babbler.

The rediscovery of this species was one of the most interesting results of the Expedition. I collected a single male out of a small flock of seven or eight birds at Rekcha on Christmas Day. The birds were in an open field which was spotted with low patches of shrubbery, and were hunting, partly on the ground, partly in the lower branches. They were calling in a series of short-syllabled *churrs,* rather deep and musical, more like laughing thrushes than the typical 'Seven Sisters', and I thought at the time and afterwards when I had first examined the bird, that I had something close to *Garrulax lineatus.* The bill of the Spiny Babbler is particularly reminiscent of *Garrulax* in addition to what I heard of its voice. The feathers of head and mantle, throat and upper breast of course have strong spinous shafts. Contra Delacour (1947, p. 20) who says merely that the genus *Acanthoptila* 'cannot be maintained', I feel that it serves as a valid link between *Turdoides* and *Garrulax.* Its generic characters may be listed as the distinctive spiny shafts above alluded to, and reduced rictal bristles, more prominent, however, than in *Turdoides.* In bill shape, nostrils, under-wing coverts and legs it is like a typical *Garrulax.* In plumage pattern, tail and wing shape and size it is like *Turdoides.* Its voice seems to be more like *Garrulax* than *Turdoides,* its habits similar to species of both.

Soft parts: iris white; bill, upper mandible brownish-black, lower light gray on the basal half, distally black; legs light brownish-gray. Wing 84, tail 104, bill (from skull) 24.5, tarsus 30.5. This specimen is a fully adult male and is normally colored with a white superciliary, ear coverts, throat and upper breast. I believe the occasional variable amount of white referred to by Baker (1924, p. 203) is an individual variation.

Of the seven specimens listed by Sharpe (1883, p. 380), the Bird Room staff at the British Museum could find only three in April 1949. In addition there is one skin in New York received in exchange, making a total of four. This new skin is the first collected since Hodgson's or Pinwill's time and represents the first seen alive by an ornithologist. It is illustrated on the accompanying plate reproduced by courtesy of the National Geographic Magazine. Evidently this is a hill species of the 5,000 ft. zone in open scrub or secondary growth in west Nepal. Its habitat preference should allow it to survive and tolerate to a considerable extent the rapid deforestation which is occurring at that level.

Garrulax albogularis albogularis (Gould): White-throated Laughing-thrush.

The commonest of the laughing-thrushes encountered by us in western and central Nepal from 4,000-6,000 ft. It was a bird of the scrub and light thick jungle. At Rekcha large winter flocks of this species were often out on the open paddyfields in the early morning apparently feeding on insects, doing a considerable amount of scratching and digging with their powerful feet about the young shoots of rice and barley. Breeding specimens were taken in March and April round Godaveri and Naggerjung. Soft parts: iris white; legs bluish or whitish-gray.

Garrulax striatus vibex Ripley: Nepal Striated Laughing-thrush.

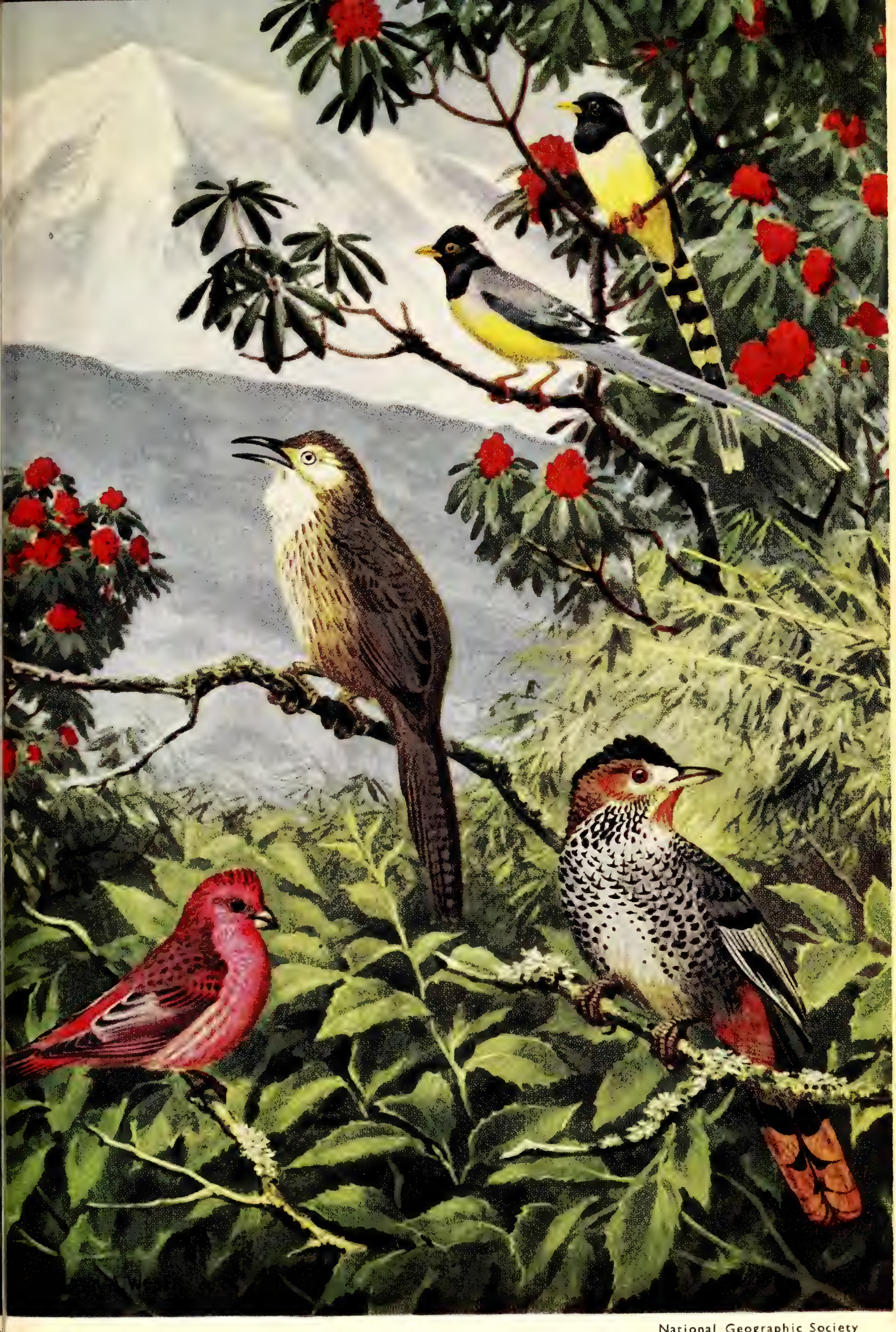
This species appeared common at Godaveri in thick second growth. Birds were breeding in late April and were separated at that time from the hunting flocks of other laughing-thrushes, being only with their own kind. A young bird in adult plumage with pointed tail feathers was collected there in late November. This is an intermediate population, darker than *striatus,* and noticeably paler than *sikkimensis*. Birds from western Nepal also belong to this race.

Garrulax striatus sikkimensis (Ticehurst): Sikkim Striated Laughing-thrush.

This darker race was found at Mangalbaré in thick forest just below 9,000 ft. in February, a higher range than is ordinarily attributed to this species, but one perhaps made necessary by the absence of any evergreen forest in this area at lower altitudes.

Garrulax leucolophus leucolophus (Hardwicke): White-crested Laughing-thrush.

The White-crested Laughing-thrush was local and only collected by us at the following localities: the Valley, December and April;



National Geographic Society

Yellow-billed Blue Magpies (*Kitta f. flavirostris*)

Spiny Babbler (*Acanthoptila nipalensis*)

osefinch (*Carpodacus n. nipalensis*)

Grosvenor's Laughing-thrush (*Garrulax r. grosvenori*)

Bhimpedi May; west Nepal at Chisapani, 1,000 ft. and Rekcha, 5,000 ft. (uncommon there) in December; east Nepal, Muhlghat, January and February. At Chisapani we collected only males; in the Valley in April we collected only females.

In series the wing of these males and females ranges from 130-140. Birds from east Nepal are slightly darker above and below than birds from the rest of the country and range in measurements from 130-135, this cline in color and partial cline in size leading towards *hardwickii* Ticehurst of Assam, as pointed out by that author (1926).

Garrulax rufogularis grosvenori Ripley: Grosvenor's Rufous-chinned Laughing-thrush.

This laughing-thrush was a common species at Rekcha, but was decidedly inconspicuous and a great skulker. The birds had a series of alarm notes, rather harsh and loud, but when at ease calling to each other, a delightful range of chuckles and low conversational notes. A series measure: wing ♂ 87-94, 84-91. Soft parts: iris brown; bill, upper mandible brownish-horn, lower grayish-brown; legs grayish-brown. This population differs from typical *rufogularis* of central Nepal and Sikkim by being much paler and less heavily barred on the upper surface, and from *occidentalis* of the western Himalayas by being more olivaceous with larger terminal spots above and below. It is also illustrated in the coloured plate herewith.

Garrulax caerulatus caerulatus (Hodgson): Gray-sided Laughing-thrush.

A party of these birds was found at Godaveri one day in November hunting with other laughing-thrushes in heavy mixed scrub. They had not been encountered in the spring and must have been wintering birds. They had rather loud musical calls of four notes, a sort of chuckling series, not really whistled. Wing ♂ 107, 111.5, ♀ 106.

Garrulax lineatus lineatus (Vigors): Streaked Laughing-thrush.

A single male presented by Dr. Walter Koelz and taken on Chandragiri Pass where I observed a small flock creeping rodent-like over the humus and ground cover, is my only record of this species.

Garrulax affinis affinis Hodgson: Black-faced Laughing-thrush.

This was the commonest Laughing-thrush at Mangalbaré where it frequented heavy thickets in the rhododendrons, often hunting in parties with *Alcippe vinipectus*. A series measure: wing ♂ 108-111, ♀ 102-107. Soft parts: iris brown; bill black; legs pinkish-brown.

Garrulax erythrocephalum erythrocephalum (Vigors) Red-headed Laughing-thrush.

A species noted only in the vicinity of Chandragiri Pass in April. These birds are red-headed, and as Nepal is given as the type locality of Oates's *nigrimentum*, it would be better perhaps to restrict the type locality of that form to Ilam district, eastern Nepal.

Leiothrix argentauris argentauris (Hodgson): Silver-eared Mesia.

Seen at Bhimpedi, and at Chisapani in west Nepal. A breeding male was shot on May 3 at the former place. Wing 77.

Leiothrix lutea callipyga (Hodgson): Indian Red-billed Leiothrix.

A bird of heavy scrub and forest remnants, found at Godaveri and Chandragiri Pass. Soft parts: iris brown; bill red, black at base; legs pale brown.

Myzornis pyrrhoura Hodgson: Fire-tailed Myzornis.

A single female was collected on a high tree in original forest at Mangalbaré from a flock of mixed species. Soft parts: iris dark brown; bill black; legs yellowish-brown. Not recorded from Nepal since Hodgson's time, although Stevens (1923) secured a series on the Singile La Ridge on the Nepal-Sikkim frontier at 10,160 ft. in March.

Pteruthius erythropterus (Vigors): Red-winged Shrike-babbler.

Met with only at Chandragiri Pass. Wing ♂ 82, ♀ 83.

Actinodura nipalensis nipalensis (Hodgson): Hoary Bar-wing.

The Hoary Bar-wing was taken at Chandragiri Pass in late April. Soft parts: iris brown; bill black; legs light grayish-brown. Birds in worn plumage were collected in May. A pair measure: wing ♂ 93, ♀ 88.

In Hodgson's time (1836) this Bar-wing could apparently be found in the garden of the British Residency in Katmandu, a far cry from conditions as they exist today. Bearing that in mind, however, I have restricted the type locality of *nipalensis* (l.c., 1950) to the slopes of the Katmandu Valley.

Actinodura nipalensis vinctura Ripley: Eastern Hoary Bar-wing.

The Bar-wings found at Mangalbaré agree with Sikkim and Bhutan specimens in having a much wider black terminal bar on the upper surface of the tail than in the nominate form, and also having heavier black barring on the wings and tail.

We found these birds in dense thickets on the edge of evergreen jungle. They were shy and skulking and raced through the thick growth from branch to branch with the ease of a squirrel.

Siva strigula strigula Hodgson: Stripe-throated Siva.

In contrast to Scully's observation (1879), we did not find the Stripe-throated Siva common around the Nepal Valley, although birds were seen above Godaveri in late November. In east Nepal the species was very common above Chitré and at Mangalbaré. A series measure: wing ♂ 68-73, ♀ 64-68. Soft parts: iris brown; bill, upper mandible grayish-brown, lower grayish-white; legs gray, or brownish-gray.

Siva cyanuroptera cyanuroptera Hodgson: Blue-winged Siva.

A pair were taken in thick scrub at Godavari in November. Wing ♂ 65, ♀ 63.

Yuhina flavicollis albicollis (Ticehurst & Whistler): Western Yellow-headed Ixulus.

This Ixulus occurred at Rekcha. A single female has a wing of 65.5. Soft parts: iris brown; bill, upper mandible blackish-brown, lower light brown; legs dull yellow. This specimen compares perfectly with birds from farther west along the Himalayas.

Yuhina flavicollis flavicollis Hodgson: Yellow-headed Ixulus.

A busy active little bird, working in flocks through the scrubby bushes (mostly *Randia* and alders, at Godaveri. Found also at Chitré associated with *Y. gularis*.

Yuhina gularis gularis Hodgson: Stripe-throated Yuhina.

The Stripe-throated Yuhina was met with on Chandragiri Pass and at Chitré and Mangalbaré, usually well up in trees, where it was very active in small flocks of its own kind, or on occasion with *Y. flavicollis*. They have a characteristic series of twitters with sharp alarm *cheeps*. Birds in worn plumage were taken in late April. Fresh-plumaged east Nepal birds seem richer, more olive-tinted than birds from the Valley, but I lack specimens in truly comparable plumage. Soft parts: iris brown; bill blackish-brown; legs yellow.

Yuhina occipitalis occipitalis (Blyth): Chestnut-headed Ixulus.

Large flocks were in the tops of berry-bearing trees at Chitré in late January. Where the species occurs it seems to be very numerous. Soft parts: iris brown; bill brown; legs orange-brown.

Yuhina zantholeuca zantholeuca (Hodgson): White-bellied Erpornis.

Our experience in meeting this bird at 6,000 ft. in spring and late autumn in the Valley agrees with that of Stanford in Burma (1941), and is in contrast to the 'Fauna' (1924) where the range of the Erponis is given as the plains up to 3,000 ft. I note that Mrs. Proud (1949) also found these birds on Naggerjung. Our specimens from the Valley were in breeding condition in mid-April. We found the species occurring singly or in pairs in the low shrubbery on Naggerjung, not associated with other species either in the spring or autumn.

Alcippe castaneiceps castaneiceps (Hodgson): Chestnut-headed Babbler.

The little Chestnut-headed Babbler is a rather shy bird, haunting the heavy undergrowth on the edges of clearings in evergreen jungle. We found these birds in small active flocks at the Chandragiri Pass in central Nepal and at Tinjuré in east Nepal. I doubt if this species winters below 3,000 ft. in Nepal, whereas Stevens (l.c.) reports it occurring down to 2,400 in Sikkim, and in Assam it descends to just below 1,000, another example of birds from the eastern part of the Himalayas descending lower down the slopes of the hills than their relatives in the western part of the range.

Males and females measure: wing 57-59, tail 41-44.5. I hereby restrict the type locality of this subspecies to the Chandragiri Pass, central Nepal, a locality where Hodgson's collectors probably found it. Mr. H. G. Deignan has been kind enough to assist me in looking over specimens from Siam of this species, which is particularly subject to post-mortem change. Comparison of considerable series from Nepal, Sikkim, N. Burma, Tenasserim, Yunnan, Siam and Tonkin both of fresh and old skins shows the following differences:

In fresh skins;

Central Nepal.—paler, particularly on the crown and lighter on the crown and flanks. No size difference.

Eastern Nepal and Sikkim.—darker on the crown, and darker, more olive on the back and flanks.

In old skins (10 or more years old);

India, Sikkim, Burma, Yunnan.—lighter on the crown, more olive on the back.

Siam.—intermediate, some lighter, some darker on the crown, some grayish-olivaceous on the back, some more rufescent.

Tonkin.—darker, more blackish-rufescent on the crown, more rufescent on the back.

From the above it would seem as if there were a continuous cline of color differences, but a comparison of equally foxed or equally fresh skins from the whole range would be necessary to determine the exact shade of differences. From the speciation point of view there are probably several different populations, but I hesitate to recognise them. From the point of view of convenience in arranging these specimen in drawers in a museum (a necessary if arbitrary process) I would be inclined to recognize *castaneiceps* as the race of Nepal, Sikkim, Assam, Burma, Yunnan and Siam, and *exul* Delacour as the race of Laos and Tonkin.

Alcippe vinipectus vinipectus (Hodgson): Hodgson's Fulvetta.

An uncommon species in the Valley, seen only at Chandragiri in April.

Alcippe vinipectus chumbiensis (Kinnear): Eastern Fulvetta.

The Eastern Fulvetta is a much darker form than Hodgson's Fulvetta with streaking on the throat which is absent in most specimens of the nominate race. This little Fulvetta was one of the commonest wintering birds at Mangalbaré in February. The birds moved through both substage and upper layers of the forest. It was in mixed flocks with other species and again in uniform flocks. An interesting feature of our series was that out of fifteen specimens taken, only two were males. Possibly the sexes tend to segregate out at different altitudes in winter.

Alcippe nipalensis nipalensis (Hodgson): Nepal Quaker Babbler.

This little quaker babbler proved to be very common in the Valley in second growth or the remnants of evergreen forest as at Godaveri. We found the species breeding in late April. Worn-plumaged specimens were taken in late April, and freshly moulted birds in late November. A series of both sexes measure: wing 58-62, tail 57.5-66. This babbler was not found in either western or eastern Nepal, in the latter area probably missed due to the difficulties of hunting in so denuded an area.

Heterophasia capistrata nigriceps (Hodgson) : Nepal Black-headed Sibia.

The Black-headed Sibia is one of the commoner birds in the forests at 5,000 ft. and above. Its melodic whistling call rings across the hills about the Chandragiri Pass where we heard it both in autumn and spring.

The name of this form is in some doubt. Ticehurst and Whistler in their paper restricting Vigors's types to one blanket area in the western Himalayas, stated categorically (l.c. p. 473) that '*Leioptila*' *capistrata* did not have a fixed type locality. Unfortunately they overlooked Baker who in the 'Fauna' (l.c. p. 296) had listed the type locality as Darjeeling. This seems firm enough. In addition Hartert (1891) in his original description of *pallida,* had referred to specimens discussed by Sharpe. (l.c. p. 404) from Butan and Nepal, and had said that Sikkim birds showed the characters of typical *capistrata.* There seems no sensible reason then to attempt to change the restricted type locality for *capistrata* from Darjeeling, as Vigors's original collection was a composite one.

I can distinguish three populations based primarily on color, but also on size. In the west Hartert's *pallida* extends from Hazara to Garwhal. This is the palest, least olive-tinted race and is slightly larger, wing 95-107. In Kumaon and western and central Nepal there is a darker, more cinnamon-colored form with a suffusion of olive in the brownish back feathers. This is Hodgson's *nigriceps* (hereby restricted to central Nepal, with wing measurements of 88-98. In eastern Nepal, presumably east of the Arun Kosi River, Sikkim and east to the Dafla Hills there is a still darker bird, the back tinged with 'clove brown'. This is *capistrata,* of which *baileyi* Kinnear (1939) is a synonym.

Heterophasia capistrata capistrata (Vigors) : Black-capped Sibia.

A common bird from about 7,000 ft. up in eastern Nepal wherever there were any remnants of forest. Call and habits exactly the same as in *nigriceps*. A series measure: wing 87.5-98, one 100.

Subfamily SYLVIINAE

Seicercus burkii burkii (Burton) : Black-browed Flycatcher-warbler.

Common from the Terai up to 6,000 ft. in all parts of Nepal. Western birds are slightly paler, less olive-tinted on the upper parts, thus showing the beginning of a cline towards *whistleri* of the western Himalayas. This series measures: wing ♂ 55-61, 53-56.

Seicercus xanthoschistos xanthoschistos (Gray) : Gray-headed Flycatcher-warbler.

This little warbler seemed to be the most common resident species in the Valley. Males were in breeding condition in April. Wintering birds in west Nepal were taken as low as 950 ft. These specimens measure: wing ♂ 51.5-58, ♀ 48.5-53.5.

Seicercus castaniceps castaniceps (Blyth) : Chestnut-headed Flycatcher-warbler.

This species seemed uncommon. Only two females were secured at the Chandragiri Pass in April and in the eastern Terai in February. The April bird is moulting. The other specimen has a wing measurement of 53. A species of thick forest, usually fairly high up in the substage or canopy.

Abroscopus schisticeps schisticeps (Hodgson) : Black-faced Flycatcher-warbler.

A forest species met with only at Chandragiri Pass in May.

Phylloscopus affinis (Tickell) : Tickell's Willow-warbler.

Collected in the Valley in scrub jungle at Thankote, Gokarna and Naggerjung in April, in the eastern Nepal Terai at Dharan Bazaar in January, and in the west at Rekcha in December. A male in breeding condition was taken in early April. Males measure: wing 59,60, females 55-58. The size, the color of the lower mandible and the greenish yellow underparts are diagnostic for this species.

Phylloscopus subaffinis arcanus Ripley : Western Buff-bellied-Willow-warbler.

The discovery of this new subspecies of the Buff-bellied Willow-warbler has been one of the most interesting features of the Nepal Expedition. It extends the wintering range of the species west for seven hundred and fifty miles. This race is characterized by being paler, less saturated with olive-brown or fulvous. In addition the tail is longer, absolutely and in proportion, and the bill is longer. Three females taken at Tikapur and on Naggerjung measure: wing 51-55, tail 51.5-54, tail-wing index 93-103%, bill (from skull) 12-13.

The birds taken at Tikapur were in low scrubby bushes (*Zizyphus*) on sandy islands in the Karnali River. They were secretive and shy making only a single wren-like 'tick' call. Here they were associated with *Cettia brunneifrons* and *Timalia pileata* in a situation close to the ground which seemed to me very unphylloscopine. Soft parts : iris brown; bill brownish-horn, base of lower mandible flesh-colored; legs pale brown.

This species is similar to Tickell's Willow-warbler, but somewhat smaller, more buffy-yellow below and with a short second primary and darker lower surface of the bill.

Phylloscopus fuscatus fuscatus (Blyth) : Siberian Dusky Willow-warbler.

A single female was taken in January at Biratnagar in a small patch of trees a mile or two from the town. Wing 57.5.

Phylloscopus pulcher pulcher Blyth : Nepal Orange-barred Willow-warbler.

This subspecies was found by us in east Nepal. As Blyth's name, *pulcher,* was given in 1845, to a Hodgson skin, and as many of Hodgson's specimens of this period came from east Nepal or Sikkim, I should like to restrict the type locality of this, the nominate race of the species to Ilam district, east Nepal.

Birds from Sikkim, Assam, N. Burma and the Chin Hills all agree with my east Nepal specimens in being dark on the upper surface. The subspecies probably extends as far west as the Arun Kosi River. These birds were taken at Mangalbaré in rhododendrons and conifers down to 8,000 ft. in February. Wing ♂ 60-61.5, ♀ 59-63.5.

Phylloscopus pulcher erochroa (Gray) : Katmandu Orange-barred Willow-warbler.

Gray's name (1846) may be revived for this form, and I hereby restrict the type locality to Chandragiri Pass, central Nepal Valley. This is a paler and possibly a slightly smaller bird than true *pulcher*. A pair in fresh winter plumage from Godaveri and the Chandragiri Pass measure: wing ♂ 55, ♀ 54.

Phylloscopus pulcher erochroa ≶ kangrae

Birds from west Nepal, taken at Rekcha in thick evergreen forest are intermediate between *erochroa* and the more western *kangrae*. In color these birds closely approach the latter but are somewhat more olive, less brownish-olive on the back, and a trace darker on the head.

Phylloscopus inornatus humei (Brooks) : Green Willow-warbler.

Found on passage from the edge of the Terai up to the Valley in central Nepal in late April, and again in mid-November.

Phylloscopus proregulus chloronotus (Gray) : Himalayan Willow-warbler.

The type locality of this form is Nepal, and as two populations occur within the Kingdom, I hereby restrict the type locality of this subspecies to the Central Valley of Katmandu. Specimens were collected at Naggerjung and Godaveri in November in scrub and light forest. We also found *chloronotus* at Chainpur in east Nepal. Call, a soft *sip, sip*.

The name *newtoni* Gaëtke (Darjeeling), is available for the darker eastern form of Sikkim and Assam.

Phylloscopus proregulus simlaensis Ticehurst : Western Himalayan Willow-warbler.

We collected this paler, brighter subspecies at Chisapani and Rekcha in west Nepal in light forest in December.

Phylloscopus maculipennis maculipennis Blyth : Gray-faced Willow-warbler.

Birds from east Nepal agree with birds from Sikkim and the Assam Hills. Therefore in my description of the following form (1950) I fixed the type locality of this nominate subspecies as Ilam district, east Nepal. Specimens were taken at Mangalbaré in February in thick forest.

Phylloscopus maculipennis centralis Ripley : Nepal Gray-faced Willow-warbler.

Central and western Nepal Gray-faced Willow-warblers are distinctly intermediate between the dark *maculipennis* and Ticehurst's *virens* of the Punjab Himalayas, which is a much paler bird. Found in secondary scrub-forest from 5-6,000 ft. in November and December.

Phylloscopus trochiloides trochiloides (Sundevall) : Blyth's Crowned Willow-warbler.

This species was not found by us in breeding condition in Nepal. A wintering female was taken at Chatra; wing 60; third primary just shorter than fourth and fifth, but longer than sixth (Ticehurst's Key, 1938).

Phylloscopus trochiloides viridanus Blyth : Western Crowned Willow-warbler.

This species as a wintering resident, seemed to be one of the commonest Willow-warblers in Nepal in the Central area from the Terai up to 6,000 ft. It was also secured at Chatra in February. In the field and in its calls and behavior it seems indistinguishable from the Green Willow-warbler. In numbers both species seem to be equally numerous judged from the specimens collected by us.

Phylloscopus nitidus Blyth : Green Willow-warbler.

A pair of non-breeding birds were taken at Thankote in mid-April in light scrub on the hill-side near the ropeway.

Phylloscopus reguloides reguloides (Blyth): Crowned Willow-warbler.

This species was found in the western Terai in December and on Chandragiri Pass in December and April. In the eastern Terai we collected it in January. It is a species of fairly thick forest. A Chatra female has a wing measurement of 57.5. No birds collected by us showed a tendency towards enlarged gonads.

Orthotomus sutorius patia Hodgson: Nepal Tailor-bird.

Specimens of the Tailor-bird were collected at all seasons from the Terai to 6,000 ft. Males coming into breeding condition were taken in late February in east Nepal, and in April in the Central Valley. Birds from east Nepal in fresh plumage seem slightly more richly colored on the head and lower parts than do those from farther west, indicating a cline in color towards *luteus* from extreme northeastern Assam. This difference is slight, but it would seem wise to restrict the type locality of *patia* to Katmandu.

Soft parts: iris brown, light brown, light orange-brown; bill, upper mandible black, lower flesh, light horn, (once whitish-purple !); legs brownish-flesh. In the race *guzurata* from S. India, soft parts are given by us as: iris yellow-ochre; bill, upper mandible brown, lower dark flesh; legs dark flesh; indicating differences in the colors of the soft parts between the races.

Prinia hodgsonii rufula Godwin-Austen: Himalayan Gray-breasted Wren-warbler.

This was the commonest warbler in west Nepal from the Terai up to 5,000 ft. In central and eastern Nepal it seemed less common, although it was found in the Valley, and in the east, from the Terai up to 1,200 ft. Moulting birds were collected in March and breeding males in summer plumage were secured at Bhimpedi and Sisagarhi in May. Soft parts: iris reddish-brown, brownish-yellow; eyelid pinkish-yellow, dull yellow, bill black; legs brownish-flesh.

In west Nepal, we came across large wintering flocks numbering scores of individuals, working through tall weeds and grass on the forest edges or in clearings, constantly chittering and calling to each other. Only rarely did they leave the substage and ascend into the lower second-storey of the trees in the light under canopy of the forest.

Prinia inornata terricolor (Hume): Northern Indian Wren-warbler.

The only specimen of the Indian Wren-warbler taken by us was at Kauriala Ghat on the U.P.—Nepal border in west Nepal. It appears to belong to the race *terricolor* which may thus be presumed to enter western Nepal, see Whistler and Kinnear (op. cit., 1933, p. 577).

Prinia sylvatica gangetica (Blyth): Jungle Wren-warbler.

Found only in the west Nepal Terai in tall grass near the river banks. A shy skulking species. Soft parts: iris light brown; bill, upper mandible black, lower flesh, yellowish; legs brownish-flesh, flesh. A topotype of the nominate race from Segur Ghat in the Nilgiris has the lower mandible gray basally, and black distally, a possible racial difference.

Prinia socialis inglisi Whistler & Kinnear: Inglis's Wren-warbler.

A single specimen of this saturated form was found in extreme west Nepal at Tikapur, where *stewarti* might more likely be expected to occur. This extends the range of this race five hundred miles to the west, presumably throughout the Nepal lowlands. Soft parts: iris pale brown; bill black; legs pinkish flesh. Wing 48.

Prinia polychroa crinigera (Hodgson): Nepalese Hill-warbler.

Found on scrub-grown hillsides from above the Terai at just over 1,000 to 5,000 ft. A breeding male in summer plumage was obtained at Bhimpedi in Many. Soft parts: iris pale brown; bill, upper mandible black, lower light horn; legs brownish-flesh; nails black.

Wing ♂ 51-54 (winter), 61.5 (summer); tail ♂ 106-114 (winter), 114 (summer).

Tesia cyaniventer Hodgson: Slaty-bellied Wren

Tesia olivea was not collected by us in Nepal. All specimens of Wren-warbler taken by us from 500-6,000 ft. in the three areas visited have the crown concolorous with the back, the lower mandible varying from yellow to dull orange, and the light gray underparts identifying them as *cyaniventer*. The alarm call of this species is a sharp characteristic *tchirik* identical with that of *olivea*. We found the bird on or near the ground in clumps of fallen brush in evergreen jungle from the Terai up to Chandragiri Pass.

Tesia castaneo-coronata (Burton): Chestnut-headed Wren.

Seen only at Chandragiri Pass and on Naggerjung. I found these birds in scrub bushes (mostly *Strobilanthes*) on overgrown hill-sides.

The alarm note was a single distinctive *wee* repeated at intervals of several seconds. Soft parts: iris brown; bill, upper mandible black, lower orange at base, black tip; legs olive-brown. Wing ♂ 48.5-50, ♀ 46.5.

Cettia pallidipes pallidipes (Blanford); Blanford's Bush-warbler.

A single female taken in thick brush at Chisapani, western Nepal, on December 18 is a considerable westward extension of this species. It is presumably the first record west of Sikkim. I found the bird very difficult to see in dense grass and bushes in a scrub area away from the typical evergreen Terai jungle. Wing 57.5

Cettia brunneifrons brunneifrons (Hodgson): Rufous-capped Bush warbler.

Two specimens of this skulking Bush-warbler were taken; in the Valley in April at 6,500 ft. and in the Terai at Tikapur in January. The second specimen, collected by Mr. Migdalski was without a tail, and for a time I was very perplexed to identify it, as it seemed to be an unknown brown-headed *Tesia*! Found in very thick shrubbery in the open. Wing; ♀ 43, ♀ 43.

Acrocephalus dumetorum Blyth: Blyth's Reed-warbler.

Found at Bhimpedi and Godaveri in April and May. The skulking habits of this bird tempt the collector invariably. Each time it turns out to be the same migrant species again, rather than some hoped-for rarity.

Phragmaticola aëdon (Pallas): Thick-billed Warbler.

I collected a single bird in light bushes on the edge of tall grass at Chatra while following up a tiger track. It was quite silent, unsuspicious and allowed a close approach. Wing ♂ 79.5.

Subfamily MUSCICAPINAE

Muscicapa latirostris latirostris Raffles: Continental Gray-breasted Flycatcher.

Two males and a female were taken at Katmandu in April. One male had slightly enlarged gonads.

Muscicapa sibirica cacabata Penard: Nepal Sooty Flycatcher.

This species appeared in the Valley at the end of April, and was collected there on the forest edge at Gokarna and Godaveri. It sits silently on the top of tall trees in the open, occasionally hawking after insects.

Muscicapa strophiata strophiata (Hodgson): Orange-gorgetted Flycatcher.

A bird of passage not found in the Valley except in winter in late November. We collected it also in east and west Nepal from the Terai to 5,000 ft. from December through February.

Muscicapa parva albicilla Pallas: Eastern Red-breasted Flycatcher.

I am inclined to include all the Red-breasted Flycatchers collected by us in Nepal in this race. Specimens were taken in the Terai from November to February, and in the Valley in April. The commonest wintering flycatcher, found on the edges of towns and in cultivated areas.

Muscicapa leucomelanura leucomelanura (Hodgson): Slaty-blue Flycatcher.

Collected by us only in west Nepal and at Naggerjung. In the west we found it both in the Terai, and on up to 5,000 ft. in December and January, and at Naggerjung in April. No breeding specimens were taken.

Muscicapa superciliaris astigma Hodgson: Little Blue and White Flycatcher.

A pair were taken at Chandragiri Pass in late April. Wing ♂ 64, ♀ 60. The male has a trace of a white supercilium.

Muscicapa hyperythra hyperythra Blyth: Rufous-breasted Blue Flycatcher.

The Rufous-breasted Blue Flycatcher is a rather shy species, found usually as a single bird in a dense thicket in primary forest. I have never heard them utter a syllable. I have not found them high up, nor were any of our specimens in breeding condition. We collected these flycatchers in the Terai in December and February, and in the Valley in April at 6,225 ft. A male from west Nepal in fresh plumage is paler on the breast and larger (wing 63), than a small series from central and eastern Nepal and Assam (wing 57.5-61.5).

Muscicapa thalassina thalassina Swainson: Verditer Flycatcher.

This delicately colored flycatcher was the commonest breeding bird at Gokarna and Naggerjung in April. They keep much to light forest, and present-day conditions at the Preserves seem to suit them very well. Males and females in breeding condition were taken all through the month.

Muscicapa hodgsoni (Moore): Pigmy Blue Flycatcher.

A single male was shot at Godaveri on November 27. The bird was in a dense thicket in secondary scrub in similar facies to that selected by *M. hyperythra*. Wing 51. Soft parts: iris brown; bill brown; legs bluish-gray.

Muscicapa sapphira (Tickell): Sapphire-headed Flycatcher.

A female, rather badly mutilated, is our only record of this species, and the second record for eastern Nepal. It was collected at Chatra in late February in a thicket in forest. Wing 57.

Muscicapa rubeculoides rubeculoides (Vigors): Blue-throated Flycatcher.

The Blue-throated Flycatcher was breeding in the Valley along with the Verditer in late April in the same localities, Gokarna and

Naggerjung. It was also collected at Bhimpedi in May. Both species seem to enjoy the same habitat. A series measure: wing ♂ 71.5-76, ♀ 71.5-73.

Muscicapa olivaceus poliogenys (Brooks): Brooks's Flycatcher.

Brooks's Flycatcher was found at Chatra in February, a westward extension of range into Nepal, from which it had not been previously recorded. The series measures: wing ♂ 73, ♀ 71-72.5. These birds seem slightly paler on the throat than birds in similar plumage from the Khasia Hills. One female recorded as having slightly enlarged ovaries on February 10.

Niltava grandis grandis (Blyth): Large Niltava.

Uncommon. Found only on Chandragiri Pass in May. A male measures: wing 110.

Niltava sundara sundara Hodgson: Rufous-bellied Niltava.

Found at Rekcha and on Chandragiri in December and April. Uncommon and resident.

Niltava macgrigoriae (Burton): Small Niltava.

The Small Nitlava occurred at Godaveri where males were in breeding condition the end of April. A wintering bird was taken at Tikapur in January.

Culicicapa ceylonensis calochrysea Oberholser: Himalayan Gray-headed Flycatcher.

The common Gray-headed Flycatcher was breeding in the Valley in April at Gokarna and in patches of trees in the outskirts of Katmandu. In winter we found it in the western and eastern Terai in evergreen forest. For nomenclature of this species see Deignan (1947).

Terpsiphone paradisea leucogaster (Swainson): Himalayan Paradise Flycatcher.

A breeding species in Katmandu, the Paradise Flycatcher arrives usually in late March or early April. It nests commonly in bushes in some of the larger gardens around the city. Proud (op. cit. p. 705.) has a comprehensive description of nests observed by her.

Rhipidura hypoxantha Blyth: Yellow-bellied Fantail Flycatcher.

The little Yellow Fantail is found in the Valley in winter on Naggerjung, and right down to the forests of the Terai in the west. We did not collect it in the Valley in April, so that presumably it leaves earlier. Wing ♂ 56-58, ♀ 54-57. Found in tall trees, in the sub-canopy of the forest, in parkland or open woods.

Rhipidura aureola aureola Lesson: White-browed Fantail Flycatcher.

We found the White-browed Fantail only in the Terai evergreen forests in the west, where it was associated with *albicollis*. Its song is distinctive and melodic, but too short. It should go on and on but never does.

Rhipidura albicollis albicollis (Vieillot): White-throated Fantail Flycatcher.

Common in the western Terai but now rare in the Valley. This is a forest species and we did not find it except near Bhimpedi where a young bird was collected in the first week of May. A breeding male was taken in February at Muhlghat on the Tamur River.

PARIDAE

Parus major nipalensis Hodgson: Nepal Gray Tit.

A common species in the Terai from west to east, and up into the 'duns' and lower valleys. This cheery little bird is always very noticeable wherever it occurs, usually in light forest. Fourteen specimens have wing measurements of 59.5-70, and the area of white on the penultimate tail feather ranges from 22-40 mm. (aver. 31.8).

Parus monticolus Vigors: Green-backed Tit.

This hill species was seen from about 4,500 ft. along the Markhu Valley up to 9,000 ft. March specimens, which are in rather worn dull plumage, were in breeding condition. I have seen this bird in a variety of localities from open scrub to fairly heavy evergreen jungle. Males and females measure: wing 65.5-69.5.

Parus rubidiventris beavani (Blyth): Sikkim Black Tit.

A single male was taken at Mangalbaré perched in the open on top of a low tree, calling loudly in typical tit language. In size and color this specimen matches topotypes from Sikkim exactly. Wing 69, tail 45, bill, from skull 12.5. Stevens (op. cit. p. 725.) had previously recorded this Black Tit from the Nepal-Sikkim frontier.

Parus modestus modestus (Burton): Yellow-browed Tit.

The Yellow-browed Tit was found from 6,200 ft. in the Valley to nearly 9,000 ft. in the Mangalbaré area. We found them in large mixed flocks with the small Red-headed or Rufous-fronted Tits in heavy rhododendron or evergreen jungle. The birds moved rapidly and busily, hard as always to observe for any period of time. The yellow eyebrow becomes much paler in worn plumage. Wing ♂ 58.5-62, ♀ 54-60.

Parus xanthogenys xanthogenys Vigors: Northern Yellow-cheeked Tit.

Found throughout Nepal from west to east, from under 1,000 to over 6,000 ft. The commonest tit of the Valley we found these birds breeding in February, March and April. Specimens measure: wing ♂♂ and ♀♀ 64-72.5.

AEgithaliscus concinnus rubricapillus Ticehurst: Sikkim Red-headed Tit.

All Nepal birds seem to belong to this race. Although common enough in the hill round the Katmandu Valley from 5-6,000 ft., it was only once seen and collected at Rekcha, and not found by us in eastern Nepal, possibly because conditions at that altitude are now so poor for birds due to deforestation and erosion. Soft parts: iris yellowish-white, legs dull orange-brown, tan. Wing; ♂ 50-53, ♀ 48-51.

AEgithaliscus ioschistos (Hodgson): Rufous-fronted Tit.

A single male was shot out of a flock in dense evergreen cover at Mangalbaré. Soft parts: iris yellow; legs orange-brown. wing 56. I am inclined to think that this is an eastern species which will probably only be found east of the Arun Kosi River.

Melanochlora sultanea sultanea (Hodgson): Sultan Tit.

Observed by us only once in Nepal at Chatra in light forest along the river bank. A male has a wing measurement of 114.

SITTIDAE

Sitta himalayensis Jardine & Selby: White-tailed Nuthatch.

A single female taken at Chitré in evergreen forest has a wing measurement of 74.

Sitta castanea cinnamoventris Blyth: Cinnamon-bellied Nuthatch.

The commonest nuthatch of the jungle-covered Terai during winter, and at all seasons up to 6,000 ft. Males in breeding condition were taken in April in wooded areas in the Valley. A series measure: wing ♂♂ and ♀♀ 79.5-84. Soft parts: iris brown, bill black, base of lower mandible bluish-gray, whitish-gray; legs brown.

Sitta castanea castanea Lesson: Chestnut-bellied Nuthatch.

It was a surprise to find the plains form of *castanea* in the Terai jungle within four miles of where we took the preceding race. However, *cinnamoventris* is only a winter migrant into the area. Two males from Belchola and Birganj measure: wing 72, 73. Soft parts: iris brown, dark brown; bill, upper mandible black, lower gray at base; legs dark brown, dark slaty-brown.

Sitta frontalis coralina Hodgson: Velvet-fronted Nuthatch.

Common in the Nepal Valley around Katmandu and into the hills to 6,000 ft. Elsewhere we found it only in the wooded parts of the Terai. The majority of birds collected were females, only four out of thirteen specimens being males. Males and females were in breeding condition in April.

CERTHIIDAE

Certhia himalayana infima Ripley: Dark Himalayan Tree-creeper.

Kinnear (1937) states that the 'Fauna' (1922) is mistaken in assigning the range Nepal to this bird. Actually it is of course a western Himalayan species and we found it only at Tikapur and Chisapani in the western Terai where wintering birds were collected in December and January in forest. This is then the first valid record of the species from Nepal, and the specimens taken proved to belong to an undescribed dark subspecies noticeably darker, more blackish above than *h. himalayana* from Simla and southern Kashmir. These birds are marked on the head, nape and upper back with sharply defined narrow streaks of buffy white, in far sharper contrast than the typical form because of the basal color of the feathers. In addition the barring on the tail is darker, more distinct and more blackish.

A male and two females have wing measurements of ♂ 64, ♀ 67,68.

Certhia familiaris mandelli Brooks : Nepal Tree-creeper.

This species was found at Mangalbaré in rhododendron forest. Three females measure: wing 63-65. For the name see Kinnear (1935). Soft parts: iris brown; bill, upper mandible black, lower pinkish-white; legs brown. I am inclined to think this is an eastern form, found in Nepal only as far west as the Arun Kosi.

Certhia discolor discolor Blyth : Sikkim Tree-creeper.

Three females were collected at Godaveri in open forest where it apparently winters, as it had not been found there in spring. This is probably the species seen by Proud (op. cit. P. 701.) on Sheopuri and Phulchok. These birds measure: wing 66-68, culmen 15-16.

Certhia nipalensis Blyth : Blyth's Tree-creeper.

A single female of this species (formerly called *stoliczkae*), was taken at Mangalbaré in dense rhododendron forest. Wing 69.5, tail 71.5, culmen 12.5. Soft parts: iris brown; bill, upper mandible black, lower pinkish-white: legs brown. The species has not been recorded from Nepal except for a single Hodgson specimen cited by Kinnear (op. cit. 1937). I imagine it is an eastern bird found only as far west as the Arun Kosi.

Tichodroma muraria (Linnaeus) : Wall-creeper.

A single bird was observed on an open rock cliff at 6,500 ft. in east Nepal in February.

DICAEIDAE

Dicaeum ignipectus ignipectus Blyth : Fire-breasted Flowerpecker.

This flowerpecker was found from 6-9,000 ft. Males in breeding condition were collected in February and April. One male was caught in a bird net in a clearing in cut-over scrub. Soft parts: iris brown; bill black, base of lower mandible whitish (♂), orange-flesh (♀); legs dark brown, black.

Dicaeum concolor olivaceum Walden : Plain-colored Flowerpecker.

Found in the Valley, breeding in mid-April on Naggerjung. These birds measure: wing ♂ 45.5-48.5, ♀ 45. Perhaps the reason for our collecting only one female is the chance that they call less frequently.

Dicaeum erythrorhynchum erythrorhynchum (Latham) : Tickell's Flowerpecker.

A flowerpecker of the Terai found in west and central Nepal, mostly in open scrub, often near cultivation. A breeding male was collected in January at Tikapur.

Dicaeum agile agile Tickell : Thick-billed Flowerpecker.

A bird of the Terai and 'duns', found commonly in east Nepal up to 2,500 ft. in flowering bushes in open scrub. Wing ♂ 64, ♀ 58-60.

NECTARINIIDAE

Anthreptes singalensis assamensis Kloss : Indian Ruby-cheek.

A single male Ruby-cheek taken at Chatra is a westward extension into Nepal for this species. Wing 55.5, culmen 14. Soft parts: iris red; legs greenish-gray.

Nectarinia asiatica asiatica (Latham) : Indian Purple Sunbird.

Birds of this species were taken in the 'duns' at Bhimpedi and on the Tamur River at from 1,200-4,500 ft. Breeding males were collected in February and May.

AEthopyga nipalensis nipalensis (Hodgson) : Nepal Yellow-backed Sunbird.

Yellow-backed Sunbirds were shot at Rekcha and near Chandragiri Pass. These specimens measure: wing ♂ 53 (2), 54, ♀ 49-51; culmen ♂ 18-20, ♀ 17-18. These birds are found in thick bushes on the forest edge.

AEthopyga nipalensis koelzi Ripley : Koelz's Yellow-backed Sunbird.

Birds from Mangalbaré are larger, wing ♂ 54-55.5, culmen ♂ 20-21.5, than spcimens from farther west. As I remarked in my description of this race (1948a) in the case of Sikkim birds, they are somewhat intermediate in size, but should be put in with Assam specimens. In addition, these Mangalbaré males are richly streaked with scarlet on the breast, a condition which my Mishmi birds showed, but which I hesitated to use as a character for the subspecies. In series however, this character shows up well, serving to distinguish east Nepal birds at a glance from those from central and western Nepal.

AEthopyga saturata saturata (Hodgson) : Black-breasted Sunbird.

A single female was collected at Gokarna. It measures: wing 49, culmen 19.

AEthopyga siparaja seheriae (Tickell) : Indian Scarlet-backed Sunbird.

The Scarlet-backed Sunbird was collected in western and central Nepal from the Terai up to 6,000 ft. on Naggerjung. Birds were evidently breeding in March and April and specimens with head moult were taken in April. A series have measurements as follows: wing ♂ 56-58, ♀ 50.5, 53; culmen ♂ 19.5-20.5, ♀ 18 (2).

AEthopyga ignicauda ignicauda (Hodgson) : Fire-tailed Yellow-backed Sunbird.

The Fire-tailed Sunbird was collected on a ridge at Powah above Dhankuta at 5,000 ft., at Chitré and on Chandragiri Pass. All of the males are in eclipse plumage, and all are in various stages of moult in January and February. Males measure: wing 57-58, ♀ 53-54; culmen ♂♂ and ♀♀ 18-19.

ZOSTEROPIDAE

Zosterops palpebrosa palpebrosa (Temminck) : Indian White-eye.

Syn : *Zosterops palpebrosa occidentalis* Ticehurst
Zosterops palpebrosa elwesi Baker

A large series of males and females from Nepal have wing measurements of 51-56. Ticehurst (1927) redescribed the northern Indian White-eye in an extraordinarily offhand way. Earlier Baker (1922) had revised some of the Oriental *Zosteropidae*, restricting the type locality of *Zosterops palpebrosa palpebrosa* to Orissa. He then separated the northern and western Indian population as *elwesi* on the basis of brighter yellower upper parts, paler under parts, and smaller size. His type locality was given as Sikkim. Ticehurst (op. cit.) revised this range to exclude Sikkim, and renamed the population, noting that it is larger not smaller than typical *palpebrosa,* but otherwise is paler and more yellow as Baker had pointed out.

Fortunately all these birds appear similar above and below, there being a certain amount of individual variation in the shade of greenish-yellow or yellowish-green, particularly on the upper parts. I would, therefore, include them all with *palpebrosa*, thus agreeing with Stresemann (1939). It is perhaps inappropriate to comment on the above nomenclatorial whirligig, but I can hardly refrain from dubbing Ticehurst's act irresponsible. It is quite clear from Baker's paper what he was trying to get at, and it is also fairly apparent from the material when Nepal specimens are included, as they should have been by Ticehurst, that Sikkim birds fit in with those from farther west.

As for measurements, they show little difference between the two populations. For *p. palpebrosa* we have: wing ♂♂ and ♀♀ 49-57 mm. (Baker's, Ticehurst's and mine), and for '*elwesi*' (including '*occidentalis*') ♂♂ and ♀♀ 49-59 mm. (Baker's, Ticehurst's and mine).

FRINGILLIDAE

Carduelis spinoides spinoides Vigors : Himalayan Greenfinch.

Two females of the Greenfinch were shot in the Valley in April and May. They measure: wing 77, 78, and are in rather worn plumage, although the May bird is half moulted.

Leucosticte nemoricola nemoricola (Hodgson): Hodgson's Mountain Finch.

Two males collected at Tinjuré and Mangalbaré measure: wing 101.5, 103.5. Two females have wing measurements of 94 and 99. Soft parts: iris light brown; bill brown, brownish-yellow at base; legs brown.

Carpodacus erythrinus roseatus (Hodgson) : Common Indian Rose-finch.

A male collected at Rekcha January 1 has been identified for me by Dr. Vaurie as belonging to this race. For comments on this species, see Vaurie (1949). In Rekcha, females were present in large flocks on our arrival in December. They were mostly feeding on weed seeds on open scrub hillsides. Males did not appear until January 1 when I shot two birds out of a small group of males in one tree. One of these birds was the specimen mentioned above. Wing 86.5.

Carpodacus erythrinus kubanensis Laubmann : Caucasian Rosefinch.

The other male shot out of the same tree at Rekcha as the preceding subspecies has been tentatively identified as belonging to this race by Vaurie.

Carpodacus erythrinus erythrinus (Pallas) : Russian Rosefinch.

The females taken by me at Rekcha and in the Valley have been identified by Vaurie as being of the *erythrinus* type, and certainly not *roseatus*. The above birds actually lie somewhere near those described in his paper (op. cit., p. 44) as '*erythrinus* subspecies'. The occurrence of these three forms all together and even arriving together and perching in the same tree, highlights the complex situation with these Rosefinches, and the depth of our ignorance about the question of the actual breeding populations of the higher central Himalayas.

Carpodacus nipalensis nipalensis (Hodgson): Nepal Dark Rosefinch.

Dr. Vaurie has kindly examined my specimens of this species and finds that a male from Godaveri taken in December seems to be true *nipalensis*, whereas a pair of birds taken at Mangalbaré in January are intermediate between *kangrae* and *intensicolor*, as indeed they should be if all three races are to be recognized.

Carpodacus thura thura Bonvalot & Schlegel : Nepal White-browed Rosefinch.

A pair from Tinjuré measure: wing 85 (2). Soft parts: iris brown; bill blackish-horn; legs brown.

Pyrrhula erythrocephala Vigors : Red-headed Bullfinch.

One or two family groups of this Bullfinch were seen at Mangalbaré in clearings in primary rhododendron forest. They were shy, flying up into the trees with a flash of the white rump and a few subdued tinkling calls, usually well out of gunshot. Two males measure: wing 79, 81.5; tail 64, 64.5. Soft parts: iris dark brown; legs brown.

Propyrrhula subhimachala subhimachala (Hodgson) : Red-headed Rosefinch.

A female was taken at 9,000 ft. at Tinjuré in pine forest (*Abies*). Wing 97.5, tail 75, culmen 14. These finches were all exceedingly shy and elusive.

Melophus lathami (Gray) : Crested Bunting.

Specimens were collected from 3,800-5,000 ft. throughout Nepal. The species appeared to be breeding at Bhimpedi in May.

PLOCEIDAE

Passer domesticus parkini Whistler : House Sparrow.

Common in the Valley. Breeding in April.

Passer montanus malaccensis Dubois : Tree-sparrow.

Common at Thankote and Gokarna.

Lonchura striata acuticauda (Hodgson) : Hodgson's Munia.

A single male coming into breeding condition was collected at Naggerjung. Soft parts: iris reddish-brown; bill upper mandible black, lower bluish-gray; legs dark gray. Wing 54.

Lonchura punctulata lineoventer (Hodgson) : Spotted Munia.

A male was moulting April 30. A fairly common species in the Terai and the Valley about grain fields.

STURNIDAE

Gracula religiosa intermedia Hay : Indian Hill Myna.

Taken by us only in the original Terai forest and foothills near Chatra. Birds were coming into breeding condition in late February and March, and the very large flocks which were characteristic of winter, were beginning to break up.

Sturnus malabaricus malabaricus (Gmelin) ; Gray-headed Myna.

A breeding bird of the Valley, where we collected specimens with enlarged gonads at Gokarna in late April. Soft parts: iris white; bill greenish-yellow, base bluish-gray ; legs dull fleshy-brown.

Sturnus contra contra Linnaeus : Indian Pied Myna.

Common throughout the Terai in gardens and near cultivation.

Acridotheres tristis tristis Linnaeus : Common Myna.

Collected in the Valley and at Rekcha. Seen also throughout Nepal up to 6,000 ft. near cultivation. Soft parts: iris light brown or gray, spotted with white; bill yellow, skin of cheeks orange yellow; legs yellow. A male was assuming breeding condition in mid-April.

Acridotheres grandis fuscus (Wagler) : Northern Jungle Myna.

Associated with the Common Myna in the Valley. Soft parts: iris yellow; bill, upper mandible yellowish-orange, lower yellowish-orange distally, black basally; legs yellow-ochre.

DICRURIDAE

Dicrurus macrocercus albirictus (Hodgson) : King Crow.

The King Crow was the common drongo of the open Terai near cultivation, and in the Valley in the open fields. An immature specimen was taken at 4,000 ft. on the edge of a paddyfield February 9 in east Nepal. Wing ad. ♂ 154, ♀ 145-148.5. These measurements are slightly smaller than those given in Dr. Vaurie's comprehensive work on this family (1949).

Dicrurus leucophaeus beavani Vaurie : Himalayan Ashy Drongo.

The second most common drongo of the Valley, found in the light pine woods and scrub at Naggerjung, Thankote, Gokarna and around Katmandu. Males in breeding condition were taken in April. Wing ♂ 139-140, ♀ 130-140.5 (one 150).

Dicrurus caerulescens caerulescens (Linnaeus): White-bellied Drongo.

This species was taken only in Terai forest at Tikapur and Chisapani. It seems to be uncommon, perhaps because of the disappearance of the forests. Measurements: wing ♂ 126.5, ♀ (= ♂ ?) 136.5.

Dicrurus aeneus aeneus Vieillot : Bronze Drongo.

Another forest drongo found in the Terai and up to 4,000 ft., but rather uncommon. A female from Chisapani has a wing measurement of 128. Iris reddish-brown.

Dicrurus hottentotus chrishna (Gould) : Himalayan Spangled Drongo.

A forest-haunting species found in the Terai near the edge of the foothills. It will undoubtedly suffer from the restriction of range as the forest continues to disappear.

Dicrurus paradiseus grandis (Gould) : Greater Racket-tailed Drongo.

The Greater Racket-tailed Drongo occurred throughout the Terai in the remaining belt of forest. Its habitat is similar to the preceding species. Measurements: wing ♂ 164.5, 168.5, ♀ 159; bill length (from anterior end of nostril) ♂ 24, 25, ♀ 23. These measurements are smaller than those given for *grandis* by Vaurie (op. cit. p. 329), but must presumably be included in that form. The separation of the races *grandis* and *rangoonensis* while unsatisfactory from a systematic point of view, affords a fine example of a continuous cline.

ORIOLIDAE

Oriolus xanthornus xanthornus (Linnaeus) : Black-headed Oriole.

Common in the Nepal Terai in areas of mixed open scrub and cultivation. These birds were breeding in March.

Oriolus traillii (Vigors): Maroon Oriole.

Seen in the 'duns' and the foothills in west and east Nepal but not collected.

CORVIDAE

Corvus macrorhynchos intermedius Adams: Himalayan Jungle Crow.

Jungle Crows were seen in the Terai commonly after reaching the forest belt, and from there were locally common on up to the highest elevations. They were active scavengers in the neighborhood of camps in the forest, performing in this respect a useful function.

Specimens taken measure: wing ♂ 314, 350, ♀ 299; tail ♂ 190, 228, ♀ 181; culmen ♂ 62, 58 (bird with wing of 350). ♀ 55.

Corvus splendens splendens Vieillot: Indian House Crow:

A female was shot at Thankote. This species is now very common throughout the open areas of the Valley at least to 5,000 ft. With the decline of the forests it will presumably work higher. Otherwise, the House Crow was found only in cultivated parts of the Terai and rarely up into the 'duns'.

Kitta erythrorhyncha occipitalis (Blyth): Red-billed Blue Magpie.

Common in woodland in the Valley above 5,000 ft. and seen also commonly at Rekcha, this species was missed by us in east Nepal, possibly due to the lack of suitable habitat. This magpie has several distinctive calls, and of course is very noticeable in flight as it undulates slowly from one hill-side to another. Wing ♂ 193.5-197.5. Males were collected with enlarged gonads at Naggerjung in mid-April.

Kitta flavirostris flavirostris (Blyth): Yellow-billed Blue Magpie.

This higher altitude species was common about 8,000 ft. and up in eastern Nepal. Although fugitive, the colors show that this is typical *flavirostris*, whose presence is thus confirmed east of the Arun Kosi River.

This magpie makes a variety of calls consisting of whistles, one rather muted double-syllable note being characteristic and reminiscent of the Crested Serpent Eagle. In contrast to Stevens (op. cit. p. 514) we did not find these birds tame, quite the contrary. They were usually decidedly wary and secretive, keeping a tree between themselves and the intruder. Wing ♂ 185-190, ♀ 178.

Kitta chinensis chinensis (Boddaert): Green Magpie.

The Green Magpie was found in west Nepal below 1,000 ft. along the Karnali River in evergreen forest. No signs of breeding were observed in December.

Crypsirina vagabunda vagabunda (Latham): Bengal Tree-pie.

Nepal birds seem intermediate compared to topotypical *vagabunda* and *pallida*. They are close to *vagabunda* in colour but large. A pair measure: wing ♂ 162, ♀ 154. Soft parts: iris (♂) dull reddish-brown, (♀) brown; bill black, base of lower mandible slaty-gray; legs (♂) grayish-black, (♀) brown.

A rather shy retiring species of open areas, found south of the forest in the Terai.

Crypsirina formosae himalayensis (Blyth): Himalayan Tree-pie.

Birds from the Katmandu Valley measure: wing ♂ 143.5, 144, ♀ 139, 141, thereby fitting in to *himalayensis* vide Ticehurst (1925). They also agree with fresh material from the Khasia Hills. Birds were coming into breeding condition in March, and had fully developed gonads in April.

I watched a party of a dozen tree-pies courting at Naggerjung, flying from one tree to another, choosing large thick trees isolated from neighboring ones. They called incessantly, a series of raucous notes.

Garrulus lanceolatus Vigors : Black-throated Jay.

These jays were found from 5-6,000 ft. in deciduous scrub at Rekcha and on Naggerjung. At the former place the birds had considerable dried reddish mud on their feet, probably from scratching at the single available water supply, a small muddy pool. A male collected on Naggerjung in late April was coming into breeding condition and has an usually large wing measurement of 163 mm. The tail measure 160, the culmen 24.

Garrulus glandarius bispecularis Vigors : Himalayan Jay.

A single male of this wide-spread jay was taken on Naggerjung in April. It has a wing measurement of 161. In color it would appear to fit best into the western race.

Nucifraga caryocatactes hemispila Vigors : Himalayan Nutcracker.

The harsh *kraa* of the nutcracker was a familiar sound at Mangalbaré from 8,500 ft. up. It seemed to prefer to sit on the tip of a tall rhododendron or Silver-fir, sometimes flicking its tail to show the white rectrices. Two males were in breeding condition in February. Wing: ♂ 218, 222, ♀ 207.5.

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JUNGLE MEMORIES

BY

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PART VII—WILD GOATS AND SHEEP

(*With two plates*)

(*Continued from p. 150 of this volume*)

SEROW AND GORAL

The serow is one of the rarest of India's game animals, and yet, with beginner's luck, a serow was the first big game which I encountered. That was in 1904, not long after I had joined the South Wales Borderers, then stationed at the pleasant hill-station of Dalhousie. There were so many of us subalterns that one's tour of duty for church parade did not often recur, so whenever possible I used to slip away on Saturday afternoon, and spend Sunday looking for black bear and goral. A favourite spot of mine was Kajiar, some 8 miles or so from Dalhousie, where there was a dak bungalow picturesquely situated in a cup of the hills alongside a small lake. On one of my first visits we were wandering quietly through the jungle, when the shikari suddenly thrust the rifle into my hands, and trembling with excitement, stammered 'Serow', with the usual injunction to *māro*. A coarse looking blackish animal about the size of a donkey was staring at us within easy range, but what it was I had not the vaguest idea. I could see that it had short horns, but did not recognise it as a game animal, so hesitated to fire, and the serow gave a whistling snort and bolted. Bitter were the reproaches of my shikari, and equally bitter were my regrets when I related the affair to a brother officer and learnt what a prize I had lost.

My next experience with these animals was not till 16 years later, when I was stationed at Meiktila in Burma, and often used to run up the Kalaw ghat for a Sunday shoot. Pyinyaung, some 30 miles out was a favourite locality. The dak bungalow was sited high above the river, so was cool even in the hottest weather, and there was a glorious view extending over many miles of forest. The river afforded excellent sport with *Barilius bola* (Indian trout), a fish as good to eat as he is to catch—I see from my diary that one morning I took 42 on the fly—and it was a good centre for small game. Close at hand were numerous junglefowl as well as peafowl and a few silver pheasants, which gave us quite good bags once I had discovered how best to put the birds over the guns. Luckily I could speak Burmese pretty well so soon got on friendly terms with the *thugyee* (headman) of the neighbouring village of Nampandet, who used to provide the beaters, and with them always came his son, a nice youngster of about 15 and a keen sportsman. Not long before this lad had found a panther killing one of his father's cows and had wounded it with his old muzzle-loader. The animal charged and got him down, but he finished it off with his knife, being rather badly clawed in the process; he gave me the knife which I still have, and accepted a cigarette lighter in return. He also showed me the skull of a serow which he had shot, and informed me that they were to be found in the hills close by. I was pleasantly surprised as I had no idea that there were any in that area, and took the earliest opportunity to try for them. It proved rough going along the precipitous hill-sides, and the serow were far too wideawake to offer the chance of a fair shot. I did see two, but they were out of sight before I could raise my rifle. I talked matters over with the *thugyee* and arranged that since still-hunting had failed, we would try our luck with a beat the following week-end. Fortunately no untoward incident occurred in the P.O.W. camp where at the time I had custody of 5,000 Turks, and on the appointed date I arrived at the rendezvous to find the beaters ready. By previous arrangement a number of them had brought their old muzzle-loading guns, since we were pretty sure to put up other game in addition to the hoped for serow, and two guns could not possibly cover all the ground. Most of the weapons were museum pieces and were of course already loaded, with a piece of cotton waste between hammer and cap to lessen the risk of accidental discharge. They were carried pointing in all directions, and I remember how amused the *thugyee's* son was at the way I dodged them! I must confess that I was considerably relieved when at last we moved off to our respective posts.

In due course the beat started, and not long after I heard the most extraordinary noise from a ridge on my right front; rather like a creaking bray, but with a metallic sound. I looked through my glasses and saw a serow indulging in his unique alarm call. He was some 400 yards away, and so of course far out of shot, and anyhow, I hoped that he would break down-hill, as these animals generally do, and pass close to where I was stationed. But our luck was out, as none of us saw anything more of the animal, and to cut a long story short, that was the last serow I have seen or am likely to see now. And so my memories of this uncouth but interesting animal are confined to those I have seen, and not to those I have shot. But I can look back on my lack of success without regret, remembering the happy days I spent in those jungles and the good friends I made. Of goral also I have little to record, except that one fell first victim to my rifle. That was beyond Kajiar, not far from where I met my first serow. We were going along the bridle path early one morning, when my shikari pointed out a herd on the grassy hill-side not far above us. I was making no mistake this time, so fired quickly at the largest, and a lucky bullet through the neck brought the buck rolling down almost to our feet. It was not a good head, but I treasure it as my first big game trophy, and have it still, or what remains of it after so many years, for the points are broken off and it has suffered from beetles also.

I went out from Dalhousie on a number of occasions afterwards, but never got another chance. Either a puff of wind gave us away, or, as more often happened, the clouds came down and obscured our view during the final stages of the stalk. Nor did I have any better luck with the Burmese goral which I tried for more than once on the Sinlum Kaba hills above Bhamo years afterwards. From their tracks and droppings they seemed few in number, and I do not remember even seeing one. I should have liked a specimen, if only for comparison with the Himalayan variety.

OORIAL AND SIND IBEX

While stationed at Karachi in 1905, I heard that oorial (locally known as *gudd*), were to be found in the hills across the Sind border, in what was then unadministered Baluchistan. Fortunately my C.O. was all in favour of his officers going out shooting. He considered, quite rightly, that shikar taught self-reliance and an eye for country, so I had no difficulty in getting 10 days leave. For some months I had employed a shikari with his riding camel for small game shooting, and to him I left all arrangements regarding route and destination. I was very young and inexperienced but tremendously keen, and it was with feelings of the keenest anticipation that I prepared for this, my first shikar trip.

It was May and about the hottest time of the year, so it was decided that as much as possible of our first long march should be done during the hours of darkness, to avoid the heat of the day. Accordingly we left cantonments with our four camels at 2.30 p.m. and, with short halts, trekked all through the night, arriving at the site of our first camp at 6.30 a.m. next morning. In all we had covered about 60 miles, and the going was quite good till we reached the hills. Occasionally my mount would stumble, and to this day I remember the shikari's muttered objurgation 'Be-īmān' (faithless one) and the thwack of his cane against its neck. Only at one place did we encounter much difficutly, and that was in negotiating a passage between towering walls of rock, stark in the moonlight and so narrow that there was scarcely room for a single animal to pass. Here we had to dismount and coax the protesting camels one by one over the boulders which formed the path. It was a long trek and at times I found it hard to keep from falling asleep in the swaying saddle. We were all glad to reach our camping ground, and while the local trackers were being summoned by smoke signals, I had time to look about me. To the east was the precipitous range through which we had passed overnight while around was an extraordinary jumbled mass of ridges, ravines and sandhills, bare except for some scattered thorn and cactus bushes. A more inhospitable country-side it would be hard to imagine. It was through this desert that Alexander the Great led his army on his withdrawal from India in 325 B.C. I could appreciate the difficulties which his troops encountered. Students of history will remember Arrian's description of that march: how the blazing heat and scarcity of water destroyed thousands, and how the soldiers were obliged to burn or discard the greater portion of the rich spoils they had collected in India. The scarcity of water affected us also throughout the trip. My diary records that the water-hole at our first camp was only a foot square and three feet deep. It filled very slowly and even after filtering and boiling the water had a foul taste. It was in fact with difficulty that we obtained sufficient at any camp to drink, and of course baths were out of the question.

Typical gudd or oorial country

Photos *Author*

Camp in gudd country

Meanwhile the local trackers had arrived—as was the custom we had brought food and tobacco for them during their stay in camp—and over a smoke we discussed prospects of sport. I found that the usual procedure was to send out men in pairs in different directions at dawn, while I was to proceed to a centrally situated and pre-arranged spot and there await reports. In such a huge area of broken country and with limited time at one's disposal, this is the only method likely to produce results, but when information takes long to come in, the tedium of waiting becomes very trying, situated as one almost invariably is on a bare rocky hill-side in the blazing sun without shade of any description. However on this trip *gudd* were numerous, though I found them extraordinarily difficult to pick up against the drab-coloured background. Shifting currents of wind and wideawake ewes also spoilt more than one stalk, and even when I did manage to get within shot it proved far from easy to pick out the largest head. Owing to the intense heat, my rifle was shooting high, and I missed several chances before I discovered the cause; but I did succeed in bagging two rams with sizable horns, though the heads were not destined to remain long in my possession, being lost during my transfer to the Indian Army soon after. However, poor as the actual results were, this initiation in shikar taught me a lot, not only as regards the pursuit of game, but all that is comprised in that admirable word *bandobust,* without which no trip can be a success. Looking back now, I am surprised that I made so few mistakes, but in those days youngsters were taught to be enterprising, and to find out things for themselves. In spite of the appalling heat and the difficulty about water, I have very pleasant memories of that trip, and no regrets.

Service in other parts of India, Burma and Mesopotamia then intervened, and my next visit to Karachi was not till 1918, when I arrived in command of an Indian battalion just formed at Basra. It was one of the 150's whose cryptic numbering kept the Turkish Intelligence guessing for some time as to how a complete new Division had materialised overnight apparently out of the blue; but that is another story. Our stay in India was intended to be short but the Armistice intervened, and having had little respite during the war, I had no difficulty in obtaining 10 days leave. I was warned that *gudd* had been shot out in the area which I had visited 13 years before, but hoped that by going further afield I should be able to find some sizable heads, and with luck might get a Sind ibex also. My old shikari, Pinnaya, had rejoined me, and to him I left all arrangements for transport. This time we had 10 camels, as one of my officers accompanied me, and according to custom we took with us a good supply of food and tobacco for the local trackers. Car to Maggar Pir and thence by camel brought us to the rest house near the bank of the Habb river where we stayed the first night. It was here that an amusing incident had occurred not long before. A couple of officers had been fishing in the river close by, and returning late, had left one of the dead baits still mounted with the rod standing in a corner of the room. During the night a wild cat entered and took the bait. It was well and truly hooked, and bolted out into the compound running out most of the line before it broke free. The screech of the reel and the cat rushing madly round the room in pitch darkness caused no little 'alarm and despondency' until the real cause was ascertained. However our night was undisturbed, and a long trek next day brought us to our first camp which was situated considerably north of the ground which I had worked before. The terrain also was different. Here there were no dunes of shifting sand, and the hills were much higher, rising in preceipitous cliffs of some 2,000 ft. The plain around was covered with thorny bushes and grass, affording cover to hares, partridges, and sandgrouse, with an occasional Houbara bustard. These gave good sport on off-days, and a near-by *jheel* (there was no shortage of water at that season—winter) provided some excellent duck shooting. The local trackers had never before seen birds shot on the wing, and were immensely struck with the idea; every bird shot was immediately *hallaled* even though it was stone dead! Shikar comes naturally to these men who are a very stout-hearted lot. Not long before our arrival a panther had been causing considerable damage to their flocks. Six of the men tracked the beast to its lair, and having no firearms, literally hurled themselves upon it, holding it down till it was stabbed to death. That was the story they told and I saw no reason to doubt it. Several of the men had been badly clawed, as the scars showed, and the panther's skin was badly damaged by sword cuts and knife holes; the wonder was that no one was fatally injured.

Owing to the great extent of ground to be covered, we found it necessary to adopt the usual procedure of sending men out in advance in different directions. Compared with my previous trip, *gudd* were few and far between, and as often as not, no shootable rams were sighted. One day's sport only need be recorded which was not only the best, but also typical of this form of shikar. On that particular day I went out alone, as my companion was confined to camp with a badly blistered heel. Starting at dawn I rode along the base of the hills for about 4 miles; then, after sending the camels back, climbed some 1,500 ft. to the top of the cliffs, and took up my position at a pre-arranged spot. I had not long to wait before a message arrived, and an hour later joined the tracker who had remained on watch. Through my glasses I could see the *gudd* at the head of a small valley about 1,200 yards away, and since they were all rams, it was pretty certain that there would be at least one good head. The difficulty was to get within range. In front and to the right the ground sloped gently down in full view of the herd, and the only possible line of approach was along and just below the crest of the cliff on our left. Seldom have I had to work over worse ground; the rock was of friable limestone, and the narrow ledges along which we had to pass more often than not sloped outwards, with a sheer drop to the plains far below. It was anything but pleasant, but at last I reached a point 100 yards from the *gudd* and slightly above them. They had become suspicious and uneasy, so I had to take quick action. There was not much to choose between the heads, but the horns of one curved round in complete circles till they touched the neck on either side below the ears. I fired and knocked him over, and then as they bolted, killed the next best, whose horns were of the open type. Though not so large as the oorial of the Salt Range and the Himalayas, and lacking the white ruff, both were good heads for that locality; in fact I saw none better during my shoot, and was well enough contented with those I had bagged.

Hearing that Sind ibex were to be found some way further north, next day we moved camp, and that same afternoon I had my first view of these grand wild goats. A herd of about 20 had been feeding on the steep slope at the foot of the cliffs, and something had alarmed them. It was an amazing sight to see them go up and across that towering precipice of bare rock which seemed to offer no foothold at all. We were some 600 yards away, and through my glasses I had a fine view as they went diagonally up and up without the least hesitation, only occasionally pausing to balance on some small knob of rock; it was to me an eye-opener. The leader of the herd was snow-white, and I made up my mind to bag him and no other. Three days were spent in fruitless pursuit, for try as I might, I could not get within shot of him. At last, as my leave was drawing to a close, I was forced to resort to desperate tactics. Arrangements were made to drive the herd in my direction by men rolling stones down from above the cliff, while I crouched behind a rock at the top of the escarpment below. The plan worked. Several does and kids passed almost within touching distance, coming steadily on until they got our wind when of course they bolted. Fortunately the old buck was not unduly alarmed. Though obviously uneasy, he came along preceded by two smaller brown bucks, and stood just long enough to give me an easy shot. I should have killed him on the spot, but somehow failed to do so. He fell, recovered, and then in some miraculous way went straight up the sheer face of the cliff, disappearing into a cave before I could fire again. I was bitterly disappointed. The place seemed quite inaccessible, and as my leave was up, I had to leave it and return to Karachi. But Pinnaya went out again with ropes, and with their help a stout hearted man somehow managed to reach the cave and recovered the head. The mask was of course ruined, but enough remained to satisfy me as to its identity. That skull with its sweeping scimitar horns, and the two mounted *gudd* heads, look down on me as I write, and serve to recall the happy days I spent so long ago in that land of sun-baked rocks and scorching heat.

NILGIRI IBEX

He should of course be called the 'Nilgiri Wild Goat', but he has been given the name of ibex by custom and usage, and to that I shall adhere. To call him a Tahr after his Himalayan cousin seems anomalous, when one considers the age of the Nilgiris, geologically speaking, in comparison with the more recent Himalayas. However, name him as you like, he is a fine sporting animal, and not too difficult to bring to bag.

Time was when ibex in the Nilgiris were fast approaching extinction owing to the indiscriminate shooting of both sexes; for sporting ethics of those days were of a very low standard indeed. But fortunately the Nilgiri Game Association was formed, in 1879, and thanks to the control which it exercised, ibex were saved from the fate which was rapidly overtaking them. The last census which I took before the recent war showed that they then numbered, at a very conservative estimate, not less than 450, and their numbers should have increased since then.

How they will fare in the future with poaching uncontrolled and the present day lack of respect for law and order is another matter, but the reader will doubtless prefer facts to fancy, so let us omit the latter. The shooting rules of the Nilgiris permit the licence holder to shoot only one ibex annually and that must be a *saddle-back,* so called from the patch of light coloured hair in the middle of the back, which varies to some extent with the season. In very old bucks this saddle is pure white and contrasts markedly with the almost jet black of the remainder of the pelt, but such are few and far between. In the past 26 years I have in fact seen one only at which I got no chance. Ibex are found in the Kundah area from Nilgiri Peak, past Mukerti to Sispara and beyond, along that grand range of cliffs which fall precipitously many thousand feet into the plains of Kerala. They spend the nights on the actual cliffs and also retire there when alarmed, but during the daytime will generally be found grazing at the top on the short grass of the open rolling downs. Much has been written of the difficulty and danger attending the pursuit of these wild goats, owing the appalling nature of the ground. In my experience this has been very greatly exaggerated. No one in their senses would fire down at an ibex on the cliffs, for if hit, the animal is bound to be lost, since in most places they are quite unscaleable. But if the sportsman will exercise patience and wait for his shot until he can take it in the open on the grassy slopes above the cliffs, he need experience nothing more than some rather strenuous walking and a certain amount of easy climbing. There is no comparison at all with the very difficult and at times dangerous crag work which the pursuit of the Himalayan tahr entails, and having experienced the latter on more than one fruitless occasion, it was with some relief that I found how easy it is to bag a Nilgiri ibex.

Of the seven saddle-backs which I have shot, it will be sufficient to give accounts of two only. My first was in March 1923 while I was in camp at Bettmund, a famous place for ibex, some miles from Hodgson's Hut on the Krurmund river, where we had spent the previous night. We left camp at 4 p.m. and not long after, I spotted a saddleback where we had seen two females in the morning. The approach took about 20 minutes, and when we neared the spot, two ibex dashed off down the cliff. They were obviously females, so we advanced slowly, when suddenly I saw the back of an ibex in a fold of the ground not 25 yards off. He was feeding on the young green grass which had sprouted in a burnt area, and this attraction no doubt kept him from following the females. His saddle was clear, but his head was down, and I did not like to fire without seeing the horns, really quite an unnecessary precaution. I moved cautiously forward with rifle at the ready, hoping that he would stand for a second or two when he looked up. But we were too close, and when he did see us he turned and went full split down the hollow towards the cliffs. He paid no attention to my first shot, but the second brought him down head over heels, and he rolled till he caught in a bush a few yards from the cliff edge. As we ran up he revived, but my shikari seized him by a hind leg, and a bullet through the heart finished him. A fine old buck with some of the best horns I have got. My second bullet had caught him in the back above the shoulder, but as some-

Photos *P. T. French*

Nilgiri Tahr in typical terrain.

(*Note the 'Saddlebacks'*)

times happens, had apparently burst there without penetrating. I was lucky to have got him, as a few yards further would have taken him over the cliff, and he would have been lost. Judging by other experiences this was fairly typical of Nilgiri ibex shikar—too easy! And without the help of my diary I certainly should not have been able to give much detail, for until I re-read it, my sole recollection of the affair was of my shikari hanging on to the hind leg of the struggling animal until I could fire the finishing shot. I remember, however, stalking another ibex so close that when he lifted his head, with staring yellow eyes, only a bush separated us. He was a saddleback but his horns were nothing out of the way, so I let him go; it must have given him a nasty shock to see me so close! But my best memory of all is of the last ibex I shot in Nov. 1935 for the British Museum (South Kensington). I can look back on that day with some satisfaction, because, except for a gunbearer who did not know the ground, I was single handed, and had to carry the whole business through on my own.

Behind Bangi Tappal, where I was camping at the time, rises a considerable hill beyond which is a deep valley, one side well wooded, but the other with precipitous bare grassy slopes much favoured by ibex. The head of the valley is within 20 minutes walk of the bungalow, and easily accessible by a convenient col over the ridge which runs for many miles parallel to the bridle path. On the first afternoon after settling into camp, I went there to spy, not only for ibex on the open slopes, but also for a famous old sambar stag, estimated to carry a head of over 40 inches, which I had seen several times in previous years but never within range. His favourite feeding ground was the grassy ridge above the wooded side of the valley, where stood a line of prehistoric monoliths known as the 'Ghost Stones'. There were no signs of the stag, but I spotted a herd of ibex with a good saddleback on the opposite slope. They were however so far off and in such an unapproachable spot that I decided to leave them for the time being. Dawn next morning found me ensconced behind one of the monoliths, but the opposite hill-side was bare throughout its entire length of some two miles. However, being well acquainted with the ground, I guessed that the ibex had moved round the far end of the ridge into a smaller valley beyond, so decided to work in that direction. After descending some 500 feet over rather rough ground, we crossed the heavily wooded stream at the bottom, and finally after an hour's hard going reached the summit of the opposite hill. I looked over and found that I had judged correctly, for there in a hollow not 500 yards away were the ibex. The herd which I had seen the previous evening had been joined by others and now numbered about 50 including no less than three saddlebacks. A few were feeding desultorily, but most of them were lying down. Suddenly some sprang to their feet, and after staring in my direction, started to move slowly off followed by the rest. What alarmed them I cannot say; we were well hidden and the wind was in our favour; it was just one of those contretemps which are liable to happen in hill shooting. However they were uneasy rather than alarmed, so were not likely to go far before settling down again. Under cover of the ridge I moved to the left, and when I reached the end found that the ibex had split into two groups. One lot of about 30 with two saddlebacks was going to the left over rather open ground, while the remainder inclined to the right and started to feed over a low ridge which almost blocked the entrance to a side valley. As the latter included a good saddleback, I decided to go for him and to ignore the other party. There was no line of approach to the ibex in their present position on the bare slope, so I could do nothing but watch until they fed out of sight over the crest. Making sure that the last female did not return for a final glance to the rear, as is so often the habit of wild sheep and goats, I ran down to the bottom of the slope and up the other side. When I peeped over the top by the side of a convenient rock, I saw the ibex just below me and about 60 yards away. I watched them for a few minutes while I recovered my breath, and then got into a comfortable firing position, but could not get a clear view of the buck. Suddenly a watchful female spotted me and ran uphill followed by the rest, but a whistle pulled them up, and I got a nice broadside shot at about 90 yards. All bolted, but after going a short distance the saddleback staggered and fell; the little split bullet from my .318 had hit him through the heart. After taking photos and the various measurements required by the Museum, we had a well earned rest and some chocolate, and then heavily laden with the skin, head, rifle etc. took the direct line to the Sispara bridle path. Camp was reached at 3 p.m. and a pony was despatched to bring in the leg bones and such meat as was required. Meanwhile I got busy cleaning and salting the skin and head, which was scarcely finished by dusk. It was a hard day but a very satisfactory one, and it remains my best memory of the Nilgiri ibex.

(To be continued)

A PLEA FOR THE PRESERVATION OF WILD PLANTS

BY

H. SANTAPAU, S.J.

(*With a plate*)

In recent numbers of this journal there have appeared several notes asking for strong measures to be taken for the preservation of animals in general and of birds in particular. With all such pleas I sincerely and heartily agree. It is time, however, for a similar plea to be raised in favour of our rarer and more showy plants; unless strong measures are taken for the preservation of such plants, we may in a short while lose some of the finest wild plants of these parts of India.

Recently during a visit to the National Park at Borivli I was shocked to the core in face of one of those unfortunately common acts of sheer vandalism that call for the loudest protest. At the beginning of the monsoon the meadows on either side of the river from the National Park Hotel to the very foot of the Caves become covered with several species of *Crinum* (*C. latifolium, C. asiaticum,* etc.); these plants are perhaps better known to the average reader as 'white lilies'. On the occasion of my visit I examined these plants; the country-side ought to have been a paradise with literally thousands of beautiful white or pinkish flowers; as a matter of fact, not more than about a dozen plants had their flowers on, the rest showing but the remains of the stalks or scapes from which thoughtless visitors had removed the flowers.

A few days after my visit to the National Park I took some of my students to Khandala, where in an almost inaccessible part of the jungle we admired very large patches of the same lilies in all their glory (See plate). The beauty of such a spot is almost unbelievable, and the exclamations of pleasure and surprise on the part of the visitors were most delightful. Such will also be the beauty of our National Park when visitors will have learnt to respect the wild flowers of the meadows.

A few years ago coming from Poona our train stopped at Neral station; among the passengers from Matheran waiting for our train there was one with a large basket of the same lilies (*Crinum latifolium*); the ground at Neral station was strewn with decayed flowers, which obviously had been discarded by the so-called plant-lover from Matheran. Such wholesale methods of collection clearly threaten the very existence of the plant on the slopes of Matheran.

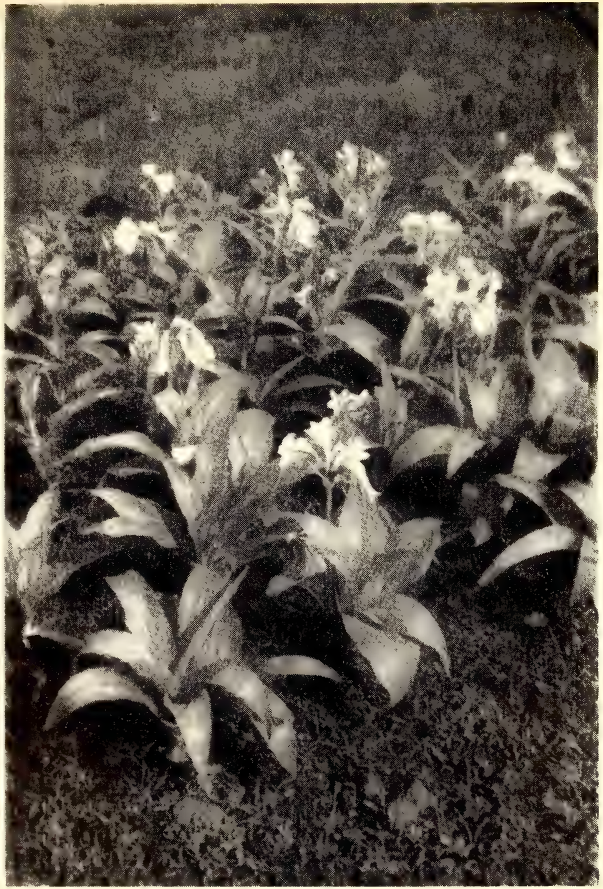
During the month of May of this year (1950) I explored the district about Khandala and made particular search for several of the commoner wild orchids *Aerides crispum* and *A. maculosum*. On one of the plateaus of difficult access from Khandala practically every tree supports over 20 beautiful orchids, which in May were in full bloom; nearer to Khandala the only plants seen were a few growing on a long branch of a fig tree in the middle of the village; the branch overlooked the village *talao* and collecting plants from such a difficult spot was not easy. For the rest the whole district is practically bare of those orchids, which a few years ago could be seen almost on every tree in Khandala.

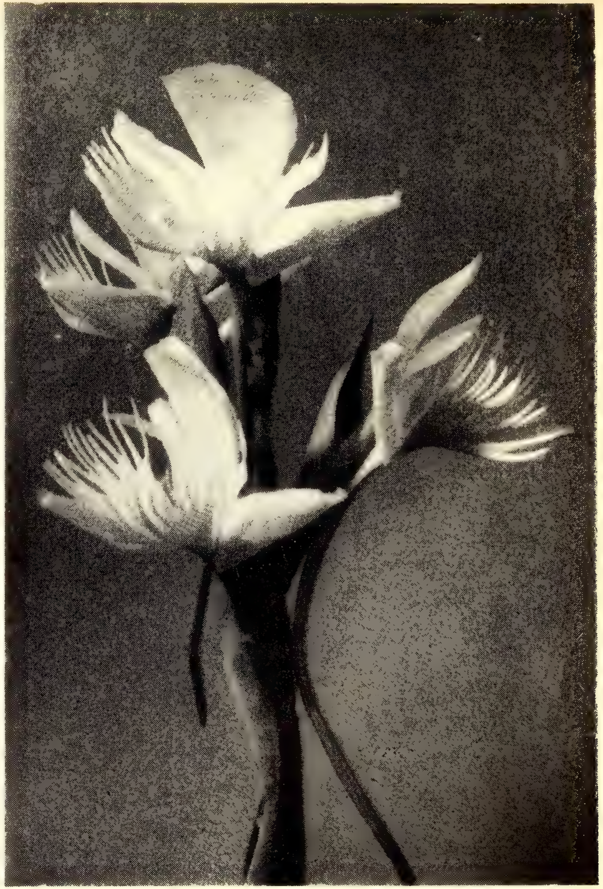
My plea for care in the collection of plants applies particularly to professors and schoolmasters and their students. Some years ago I heard from Mr. C. McCann, formerly the Joint Curator of our Society, of a case very much to the point. At a spot not far from Khandala McCann showed me a place where an otherwise rare plant, *Isoetes coromandelina,* had been growing in profusion. At the urgent request of a professor of our university McCann showed the spot to some students; shortly afterwards it was found that the whole place had been literally swept clean of any specimens of *Isoetes,* and from that time the plant has not reappeared again on the spot. This brings to my memory an experience I had whilst I was a student in the Imperial College of Science in London. In that college it was the custom for the professors to take the students out into the field for a lengthy period during the summer months. On one occasion we were shown a pond in which *Isoetes* was growing abundantly, so abundantly in fact that the whole bottom of the pond was practically covered by the plant. The professor in charge of the party instructed us that *only one plant* should be collected by each student. When some of my companions remonstrated against such apparent niggardly treatment in face of the abundance of the plant, the professor answered that it was his duty to see that future generations of students could have the same opportunity as we were having of examining such a rare plant in its native haunts.

Speaking again of Khandala, a place I have come to know very well after ten years of study and exploration, one of the finest plants both from the point of view of form and of scent is undoubtedly *Platanthera susannae,* Susan's Orchid. The accompanying photograph (plate) will give an idea of the beauty of the flower. Some years ago, according to Mr. McCann, who had been observing such plants in Khandala for over a quarter of a century, *Platanthera* was a common orchid on the slopes of Bhoma Hill and Echo Point. The beauty of the plant has been the cause of its practically total disappearance from the district. About four years ago on one occasion I noted six specimens that were just on the point of flowering; a few days later I went to see the same specimens hoping to obtain some good photographs of the open flowers; to my disappointment I found nothing but a hole in the ground from which the plants had been uprooted and taken away. Last year I did not see a single specimen in Khandala of the once common orchid *Platanthera.*

Such conduct, to say the least, is very selfish. You may find a beautiful plant in the wild state, and forgetting that other people may also enjoy seeing it, you proceed at once to remove it, perhaps soon to discard it, and thus little by little you help the country to lose some of the more beautiful and interesting wild plants.

In places such as Mahableshwar I understand that a local regulation forbids the removal of the more showy plants such as





Photos H. Santapau, S. J.

Crinum latifolium Linn.

Platanthera Susannae Lindl.

orchids and the like; this is a sensible law, but unless there is a body of public opinion behind it, the law will not prevent the disappearance of such plants. It is only by educating the future citizen of this country from the earliest years at school that positive results may in time be obtained. Love of nature in all its aspects, care for the preservation of birds, animals and plants, is a holy tradition in India; for the sake of the future of the country let us not only hand over to our descendants the natural beauties of the fields, but also try and enhance them and thereby merit the gratitude of future generations.

A PRELIMINARY SURVEY OF THE DISTRIBUTION OF THE MALLOPHAGA ('FEATHER LICE') ON THE CLASS AVES (BIRDS).

BY

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(*With 2 plates and 3 text figures*)

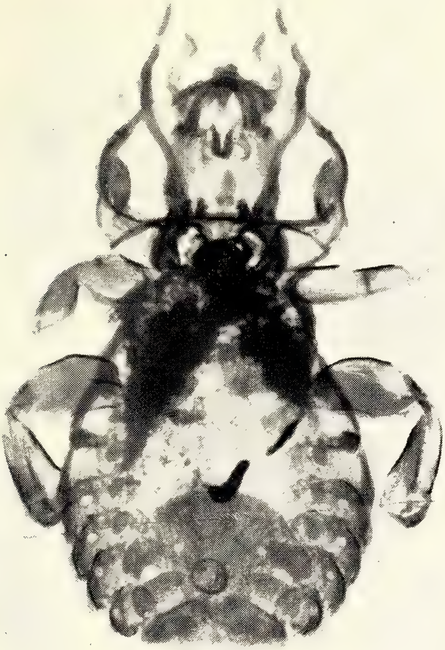
INTRODUCTION

The object of this survey is to summarise the present knowledge of the distribution of the Mallophaga on the class Aves, and to show where this distribution may throw light on the phylogenetic relationships of certain bird groups.

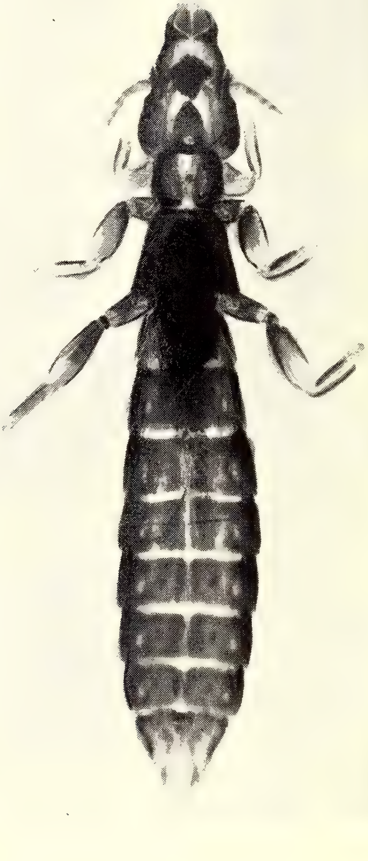
The Mallophaga are ectoparasitic insects living on birds and mammals. These parasites pass their complete life-history from egg to adult on one host, and in the majority of cases, each species of Mallophaga is restricted to one host species or a group of closely related host species. Their present distribution suggests that they became parasitic on birds at an early stage in the evolution of this latter class, and that they evolved with their hosts, but at a somewhat slower rate. This has resulted in the Mallophaga parasitizing related hosts being themselves related, and thus, in the majority of cases, it is possible by examining a specimen of Mallophaga to say from which order of birds it was taken. Any host species may be parasitized by species of one to twelve or rarely more genera, some of which are restricted to definite ecological niches on the body of the bird where their general body form seems to be adaptive to the feathers of that niche. Two of the most striking examples (Pl. 1, figs. 1-2) are the short round species found on the head and neck; and the elongate, more flattened species on the wings and back. As the Mallophaga of any one ecological niche, have evolved in a more constant environment than have the birds, they have diverged from each other less. Thus, it is usual to find a genus of Mallophaga distributed throughout an order of birds. In the case of the Charadriiformes, for instance, the species found on the head of a gull (suborder Lari) and on that of a redshank (suborder Charadrii) both belong to the same genus (*Saemundssonia*).

This general principle that the Mallophaga of related hosts are themselves related suggests that the distribution of these parasites should be valuable evidence on the phylogeny of their hosts. However there have been many factors operating during the evolution of the Mallophaga which may have obscured this initial relationship between host and parasite. These factors have been fully discussed elsewhere (Hopkins, 1942 and 1949; Clay, 1949 and in press), but may be summarised here once again:

Discontinuous Distribution. A genus of Mallophaga formerly widely distributed throughout the Aves may have become extinct on certain bird groups; its presence would not, therefore, denote relation-



1. Occupant of head niche
(*Philopterus* sp.)



2. Occupant of wing niche
(*Fulicoffula* sp.)

Habitat forms of Mallophaga

ship between the host groups on which it is now found. The genus *Colpocephalum* seems to be an example of such a genus; it has not been included in the mallophagan faunas shown in the distribution charts, as its presence or absence seems to be of little significance.

Secondary Infestations. Although it is probably rare for the lice of one host order to be able to establish themselves on the host of another order, there is little doubt that such secondary infestation is the explanation of some of the cases of anomalous distributions of of genera. The occurrence of the same genus (*Saemundssonia*) on the Charadriiformes (waders, gulls and auks), Procellariiformes (petrels) and the Gruidae (cranes) is probably an example. Among the factors limiting the establishment of a louse on a new host are the difficulties of transference and the strange environment for a species which is strongly host specific. Elsewhere (Clay, in press) the question of feather structure in relation to distribution of the Mallophaga has been discussed. Reference was made to a paper by A. C. Chandler (1916) in which this author puts forward a classification of the birds based on the minute structure of their feathers; and it was shown that the distribution of the Mallophaga in some cases supported Chandler's emendations to the usually accepted avian classification. It was suggested that this might either be a confirmation of the relationship between these groups, or that host groups with a similar feather structure might be parasitized by related Mallophaga because secondary infestation had been made possible by the similarity of feather structure—this character of the environment probably being one of the factors limiting the establishment of a host specific species on a new host.

Parallel Evolution. It is possible that parallel evolution may explain some of the cases of anomalous distribution found in the Mallophaga, although insufficient is known about the morphology and development for any certainty in these cases.

In spite of the limiting factors briefly summarised above there is no doubt that the distribution of the Mallophaga is a source of evidence which, with careful evaluation, should be utilised by the ornithologist in considering the position of birds of doubtful affinities. It is important to note, as will be made clear below, that in those cases where a bird has an anomalous mallophagan fauna there is usually a difference of opinion over its correct systematic position, and that the evidence from the Mallophaga usually supports the opinion of one school of ornithologists.

The Distribution of the Mallophaga on the Aves

Struthioniformes (Ostriches) and **Rheiformes** (Rheas). The distribution of the Mallophaga supports Chandler's conclusions from the feather structure and Lowe's (1928, 1935, 1942) from other anatomical features that these two orders are related and not the relics of independent unrelated stocks as is often stated. The ostriches and rheas are parasitized by closely related species of a specialized genus (*Struthiolipeurus*) of Mallophaga found on no other order of birds, and also by the same two species of mites (*Paralges pachycnemis* and *Pterolichus bicaudatus*) and subspecies of the same cestode (*Houttuygnia struthiocameli*) (Eichler, 1948). Lowe (1928, 1935, 1942) from studies not only of the structure of the feathers, but of many other anatomical features concluded that the Struthiones (= Struthioniformes, Rheiformes, Casuariiformes and Apterygiformes) 'represent a perfectly natural group descended from some common ancestor' (1928 : 244). The relationship between the Struthioniformes and Rheiformes is amply confirmed by their parasitic fauna—a fauna difficult to explain except by postulating such a relationship.

Casuariformes (Cassowaries, Emus). Chandler and Lowe (1928) believed that this order was related to the two already mentioned. The evidence from the Mallophaga is neutral: only one genus[1] (*Dahlemhornia*) is known, which has no obvious relationship to any other. The fact that both this genus and that from the Struthioniformes and Rheiformes show asymmetry of the head has encouraged some authors to deduce a relationship between the three host orders, but *Dahlemhornia*, as shown by its general morphology, is not closely related to *Struthiolipeurus*, and asymmetry of the head is found in another unrelated genus (*Bizarrifrons*) parasitic on the Icteridae (Passeres). The presence of asymmetry of the head of the species found on the Struthioniformes and Casuariiformes may be a case of convergence in response to some common feature in the structure of the feathers.

Apterygiformes (Kiwis). Chandler on account of the feather structure and Lowe on other anatomical features placed this order near the three orders already discussed. Although only one genus *Rallicola* (*Aptericola*) is known from this order and little, therefore, can be deduced from its presence, it is of some interest that *Rallicola* is found also on the Rallidae. This distribution supports the belief of Fürbringer (1888) that there is a relationship between apteryx and the rails. However, this mallophagan genus is also found on some of the Passeriformes, although there is evidence that there it may be due to secondary infestation. This is an example of the possibility of error in using the distribution of the Mallophaga as evidence of relationships between the hosts.

Tinamiformes (Tinamous). Chandler states (: 347): 'the structure of the down alone is sufficient proof that the tinamous are unquestionably far more closely allied to the Galli than to any other birds.' Fürbringer (1888), Beddard (1898), and others have drawn attention to the apparent gallinaceous affinities of the tinamous. Lowe (1942 : 17) and most modern classifications place them in a different superorder, the Palaeognathae, together with the four orders already considered. Evidence from the Mallophaga is here of little assistance: the Tinamiformes are chiefly parasitized by the species of one family (Heptapsogastridae) found on no other orders of birds[1] and which are presumably the descendants of a common ancestor parasitic on an ancestral tinamou. The species have filled the different ecological niches on the body of the bird and taken on a superficial resemblance to the unrelated occupants of similar niches on other orders. Some genera of this family have retained the primitive type of head found also in the species parasitic on the Sphenisciformes, Galli, and Columbae; and also bear a superficial resemblance to these species in some other characters. The species on the Galli and Columbae by the characters of their external and internal morphology seem to be truly related; those on the Tinamiformes and Sphenisciformes differ from the former and from each other in some characters of their internal and external morphology. Hence, it is not possible to say on the available evidence whether the Mallophaga parasitic on the Sphenisciformes, Galli, Columbae, and Tinamiformes are relics of not closely related stocks—those on the last three groups appearing similar owing to the retention of certain generalized primitive characters due to the similarity of the feather structure—or whether they are the only descendents left of some common stock which once had a wider distribution. This might or might not denote relationship between the Galli and the Tinamiformes. The other genera found on the Tinamiformes show no relationship to any found on the Galli, with the exception of one (*Tinamotaecola*) which belongs to a subfamily (Degeeriellinae) found not only on the Galli but on many other orders.

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[1] The evidence of relationship provided by one genus of Mallophaga is obviously less convincing than if more genera are involved, and in most cases should probably not be taken into account at all. Comparisons have therefore been made between the mallophagan faunas of host groups, that is the genera of Mallophaga normally found throughout the host groups in question.

Sphenisciformes (Penguins). The penguins are parasitized by two genera of Mallophaga which have the primitive type of head, but provide no evidence on the relationships of the hosts.

Gaviiformes (Divers) [*Colymbiformes* of European authors] and *Colymbiformes* (Grebes) [*Podicipidiformes* of European authors] The Mallophaga of these two orders throw no light on the relationship of their hosts.

Procellariiformes (Petrels). This order is parasitized by a large number (15) of genera, the majority of which are peculiar to the order, and probably developed from a common ancestor on the order. One genus (*Saemundssonia*) is also found on the Charadriiformes, and a second genus (*Procellariphaga*) either superficially resembles or is related to one (*Austromenopon*) also found on the Charadriiformes. The occurrence of these two genera may be due to secondary infestation (see Clay, 1949:292).

Pelecaniformes. This order is usually divided into three suborders: the Phaëthontes (Tropic-birds), the Pelecani (Pelicans, Gannets, Cormorants) and the Fregatae (Frigate-birds). Figure 1 shows that the Phaethontes do not have the mallophagan fauna characteristic of the Pelecaniformes, but have two genera of the fauna characteristic of the Charadriiformes. Chandler (1916:316) states. 'The third group, Phaëthontidae, is so strikingly like the Laridae [i.e. in feather structure] that their affiliation with the steganopodes [=pelecaniformes] seems very doubtful, and if feather morphology is considered, they should be looked upon rather as aberrant larid forms'. Mathews and Iredale (1921) basing their conclusions on the anatomy of the Phaëthontes placed them as a family of the Lari. Lowe (1926) on a consideration of the form of the quadrate and its tympanic relations believed that the associations of this family lay with the rest of the Pelecaniformes. Murphy (1936:796) although stating that: 'there is no doubt about the place of the tropic-birds in the order Pelecaniformes' goes on to say that: 'they differ much in habitus from all their existing relatives, and share many superficial characters with the terns. These include form and size, the shape of the beak, the silky sheen of the plumage, the voice and the aerial grace. Furthermore tropic-birds hatch from the egg covered with down, instead of being naked like young boobies, cormorants, and pelicans.'

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[1] The occurrence of one species of this family on the Cariamidae is probably due to secondary infestation.

The mallophagan fauna supports the view of a relationship between the Phaëthontes and the Charadriiformes. Alternatively, it can be argued that as members of these two groups live in the same habitat, transference of Mallophaga could have taken place and the similarity of the structure of the feathers (if this does not denote relationship) might have enabled the immigrant louse to establish itself on the new host. The fact that one of the lice in question (*Saemundssonia*) is a louse of the head, a form otherwise absent on the Pelecaniformes, would mean that the immigrant louse would have found an empty ecological niche to occupy. It must also be noted that the genus *Saemundssonia,* which probably originated on the Charadriiformes, is found not only on Phaëthontes, but also on the Procellariiformes and the Gruidae. Its occurrence on these latter host groups may be due to secondary infestations. Here, therefore, we have a case in which there is considerable doubt concerning the relationships of a group of birds. The evidence from the Mallophaga, as the evidence from any other single source, is not conclusive, but supports the views held by some ornithologists and should be taken into account in evaluating the total evidence.

Ciconiiformes (Herons, Storks, Ibises and allies). This order is usually divided into four suborders: the Ardeae, Balaenicipites, Ciconiae and Phoenicopteri. Of the eight genera of Mallophaga (omitting *Colpocephalum*) found on the Ciconiiformes only two (*Ciconiphilus* and *Ardeicola*) are common to the Ardeae (Herons, Bitterns) and Ciconiae (Storks, Ibises, Spoonbills); only one of these (*Ciconiphilus*) is known from the Balaenicipites (Whale-headed Stork), but little collecting has been done from this last suborder; the Phoenicopteri (Flamingoes) have none of the genera found on the rest of the Ciconiiformes. The Scopoidea (Hammerhead), usually regarded as a superfamily of the Ciconiae has (apart from a somewhat aberrant species of *Colopocephalum*) two genera (*Quadraceps* and

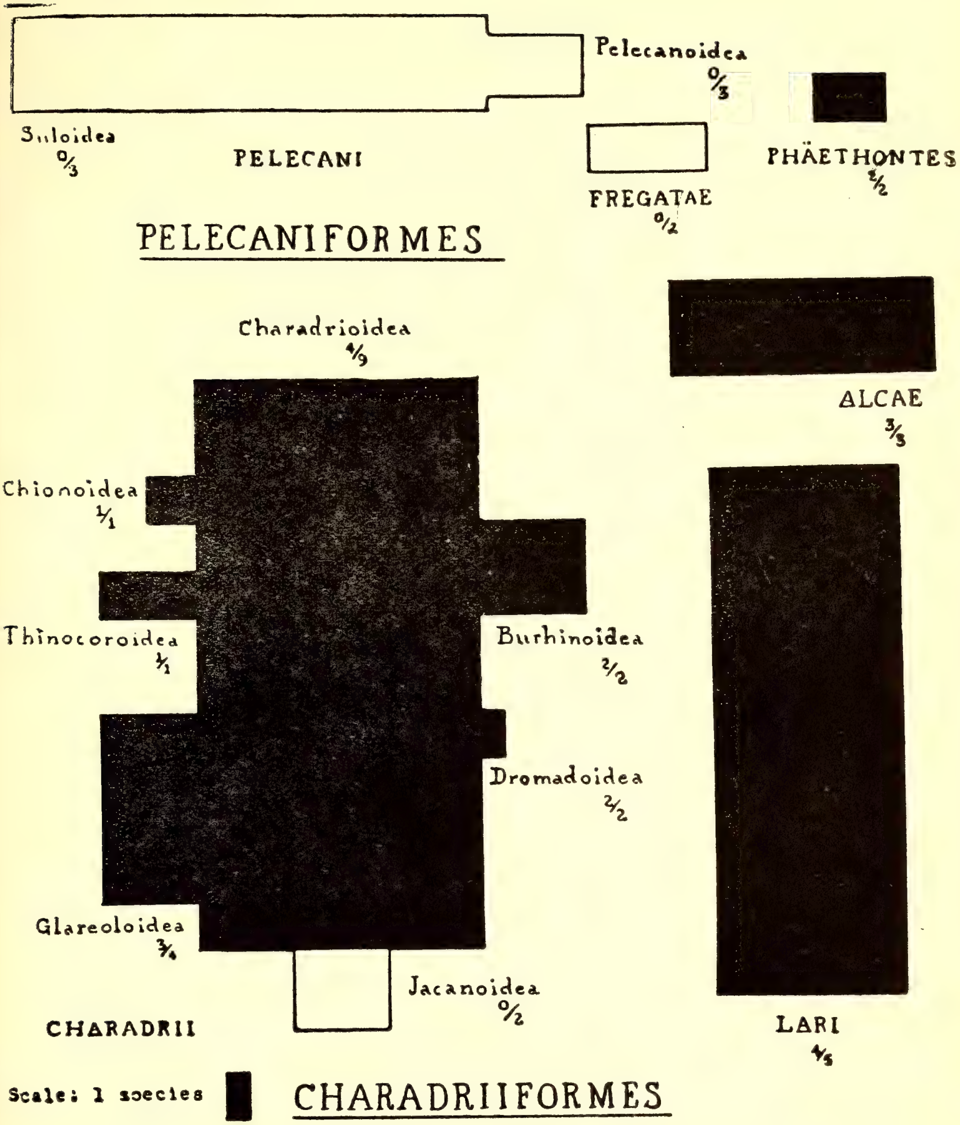

Fig. 1. Pelecaniformes and Charadriiformes (Mallophagan fauna: 4, black).

(See footnote on p. 438).

(*For explanation of chart see p.* 442).

Austromenopon) found elsewhere throughout the Charadriiformes, a distribution which may or may not be of significance (see Hopkins, 1942: 103). One genus (*Ciconiphilus*) found on the Ciconiiformes is also found on *Cygnus* (Swans: Anseriformes) and another (*Ibidoecus*) characteristic of the Threskiornithoidea (Ibises) is also found on *Aramus scolopaceus* (Limpkin: Gruiformes); a third genus (*Laemobothrion*) found on some of the Threskiornithoidea is again found on *Aramus,* but this genus has a wide distribution with species on the Rallidae (Rails), Psophiidae (Trumpeters), *Opisthocomus* (Hoatzin) and less closely related species on the Falconiformes (Birds of Prey). The distribution of these genera suggests that *Ciconiphilus* may be a straggler on the swans from the Ciconiiformes, *Ibidoecus* a straggler on *Aramus* from the Threskiornithoidea and *Laemobothrion* a straggler on this latter superfamily from the Rallidae. Although Eichler (1949) suggests that the mallophagan fauna of *Aramus* (fig. 1) may indicate a position for this family between the Rallidae and Threskiornithidae.

The Phoenicopteri (fig. 2) are parasitized by three genera found elsewhere only on the Anseres (Ducks, Geese, Swans). Chandler (1916: 320) states: 'that in the details of the minute structure of the feathers the Phoenicopteri agree with the Anseres more closely than with the Ciconiae'. Opinions on the systematic position of the flamingoes based on the internal anatomy are divided. The general

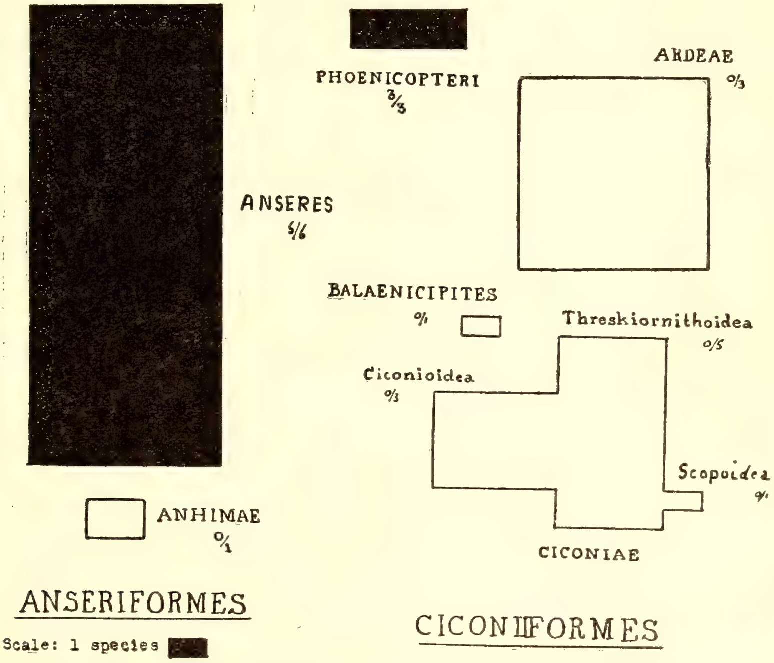

Fig. 2. Anseriformes (Mallophagan fauna: 5, black. Genera of Acidoproctidae counted as one) and Ciconiiformes.

characters of the bill and feet of the flamingoes, their habit of nesting on the ground and their call are all more duck-like than stork-like. Fossil flamingoes apparently show less elongation of the legs and have a straighter bill (Howard, 1950). On the other hand, the similarity of feather structure (if this does not denote relationship) might have allowed immigrant lice from one of the Anseres to establish themselves on the flamingoes; the common habitat in which the birds live would have made the initial transfer possible. But there are three mallophagan genera involved all suggesting anserine affinities for the flamingoes, a relationship supported by some of the evidence from ornithological sources.

Anseriformes. This order is usually divided into two suborders: the Anseres (Ducks, Geese, Swans) and the Anhimae (Screamers). The former have five genera of Mallophaga, two of which (*Holomenopon* and *Ornithobius* and its closely related genera or subgenera) are found only on the Anseres and three others (*Anaticola, Anatoecus* and *Trinoton*) found elsewhere only on the Phoenicopteri. The Mallophaga of the Anhimae throw no light on the affinities of that suborder.

Falconiformes (The Birds of Prey). The main point of interest provided by the mallophaga parasitizing this order is that a species of a genus found elsewhere in the Falconiformes only on the Cathartae (New World vultures) has been taken from *Pseudogyps africanus*[1], an Old World vulture. This suggests that the division into 'Old World' and 'New World' vultures is not so marked as indicated by the usually adopted classification, a presumption supported by the fossil record (Howard, 1950). The Falconiformes have other genera which show a somewhat inexplicable distribution and which are mentioned here without further comment. One genus (*Kurodia*) is also found elsewhere only on the owls (Strigiformes) and another (*Cuculiphilus*) is found elsewhere only on the cuckoos (Cuculi).

Galliformes (Game Birds and Hoatzins) and **Columbiformes** (Sandgrouse, Pigeons, Doves). The possible relationship of these orders to the Tinamiformes has already been discussed. The distribution of genera (or closely related genera) comprising the mallophagan fauna of the Galli (Game Birds) suggests affinities between the Galli and the Columbae (Pigeons, Doves) and the Galli and the Musophagi (Plantain-eaters). The Opisthocomi (Hoatzin) usually considered as a suborder of the Galliformes, has five genera none of which is related to those found on the Galli: no information about the feather structure of *Opisthocomus* has been found. The presence of these five genera distinct from those on any other order (except in the case of one, *Laemobothrion,* which has a wide distribution) suggests an isolated position for *Opisthocomus* within the Aves.

The Pterocletes have two genera from which no deductions of affinities can be made: one (*Neomenopon*) has no close affinities, the other (*Syrrhaptoecus*) belongs to the widespread Degeeriellinae. The Columbae have a number of genera a group of which (*Coloceras, Campanulotes* and related genera) have obvious affinities with two (*Goniodes* and *Goniocotes*) found on the Galli. Chandler states that in feather structure the Columbiformes 'show more similarities to the gallinaceous birds than to any other group', and as the mallophagan genera involved have the primitive type of head the explanation discussed under the Tinamiformes might also be applicable in this case. However, the characters (both of the external and internal morphology) common to these genera are such that it must be assumed that all the genera are related. Hence, if this does not denote relationship of the hosts, the presence of these genera must be due to secondary infestation, made possible perhaps by the similarity of feather structure.

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[1] Also from *Gyps fulvus,* see Eichler, 1944. *Dtsch. ent. Z.,* 1943:57.

The Musophagi, with four out of five mallophagan genera either the same or closely related to those found on the Galli, seem to show a definite relationship to the Galli and none to the Cuculi. This relationship has been discussed elsewhere (Clay, 1947), but at that time the paper by Lowe (1943) had not been seen. In this paper Dr. Lowe, basing his remarks on a study of pterylography, osteology and myology, comes to the conclusion that the Cuculi and Musophagi cannot be placed in the same order. Chandler states that: 'the Musophagidae do not differ in any important ways from the Cuculidae in the structure of their feathers', but he continues 'the Cuculi (=Cuculiformes) especially the Musophagidae come nearer the gallinaceous and columbid birds.'

Gruiformes (Cranes, Rails and allies) and **Charadriiformes** (Waders, Gulls and Auks). These two orders are taken together as both the anatomical evidence (Lowe, 1931:531, Chandler:353) and the fossil record (Howard, 1950) suggest that they have arisen from a common stock, probably in the Eocene; further, certain families of birds are placed in the Gruiformes by some ornithologists and in the Charadriiformes by others.

The Gruiformes comprises an heterogeneous assemblage of suborders, the affinities of some still being a matter for discussion. Figure 3 represents the Gruiformes as arranged by Wetmore, 1940, and figure 4 shows a re-arrangement based on the mallophagan faunas of the suborders.

The suborder Grues is usually divided into two superfamilies: the Ralloidea (Rails) and Gruoidea. The former has a mallophagan fauna comprising five genera; two of these genera are found also on the Psophiidae (Trumpeters) and three of them on the Aramidae (Limpkins), both these families usually being included in the second superfamily, the Gruoidea. The Gruidae (Cranes), the third family of the Gruoidea, has a mallophagan fauna of four genera, none of which is found on the other families of the suborder Grues, nor the Ralloidea. From the Heliornithes (Sun-grebes) and the Rhynocheti (Kagus)—two other suborders of the Gruiformes—genera of the ralline mallophagan fauna have been recorded. The Jacanoidea (Jacanas), a group of birds with an obscure systematic position but usually placed with the Charadriiformes, have two genera belonging to the ralline fauna[1]. These facts suggest that the Ralloidea, Aramidae Psophiidae, Heliornithes, Rhynocheti and Jacanoidea are more nearly related to each other than to the Gruidae. Evidence on the relationships between these groups from ornithological sources is conflicting. Chandler (:354) deduces from the feather structure a relationship

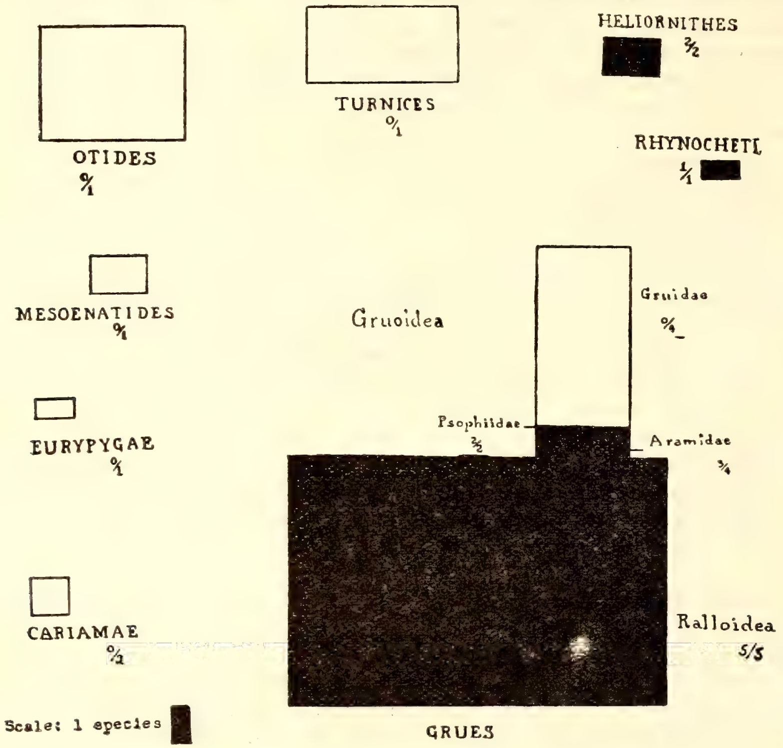
OTIDES
0/1
TURNICES
0/1
HELIORNITHES
2/2
RHYNOCHETI
1/1
MESOENATIDES
0/1
Gruoidea
Gruidae
0/4
Psophiidae
2/2
Aramidae
3/4
EURYPYGAE
0/1
CARIAMAE
0/2
Ralloidea
5/5
Scale: 1 species
GRUES

Fig. 3. Gruiformes arranged according to Wetmore, 1940 (Mallophagan fauna of Ralloidea : 5, black).

between the Gruidae, Aramidae and Rallidae and considers them offshoots from a primitive stem leading to the Charadriiformes; while the Otididae, Psophiidae (and possibly the Aramidae) he considers are more closely related to each other and may be early offshoots from the stem leading to the Columbae and Galli. This, as shown above, is in conflict with the evidence from the mallophagan faunas. Lowe (1931:496), however, considers that the Rallidae and the Heliornithidae are an isolated group and should be removed from the Gruiformes to form a separate order, the Ralliformes. This view is partly supported by the distribution of the Mallophaga, but the Ralliformes would have to include some of the families which were retained in the Gruiformes by Lowe. This latter author (1925) considers that the affinities of the Jacanoidea are not with the Charadriiformes, but with the Gruiformes; later (1931) he places them with the Gruidae not with the Rallidae in his new order the Ralliformes. Evidence from the Mallophaga of the Jacanidae, however, suggests ralline not gruimorphine affinities. Lowe (1931) considers that the Burhinidae (Stone-curlews)—placed by Wetmore, 1940 as a superfamily of the Charadrii, fig. 1—should also be placed near the Gruidae in the suborder Gruae of his order Telmatomorphae (which also includes the Charadriiformes). The Burhinidae have two genera characteristic of the mallophagan fauna of the Charadriiformes, thus confirming Wetmore's classification. Another family which has been bandied about between

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[1] Evidence has recently become available (Timmermann, in press and Tandan, in press) that the Jacanoidea also have three genera (*Quadraceps, Saemundssonia* and *Actornithophilus*) characteristic of the Charadriiformes.

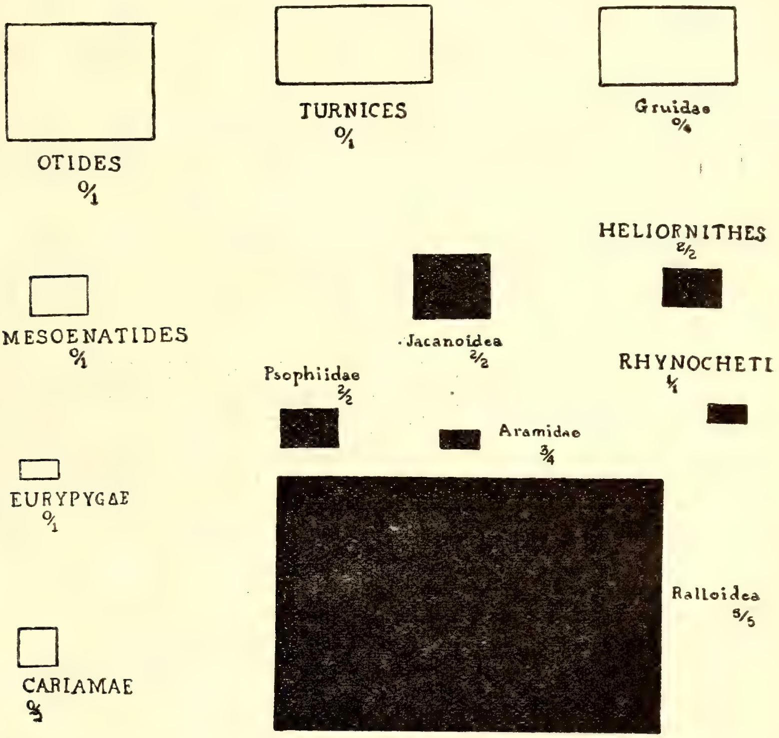

Fig. 4. Gruiformes re-arranged according to the Mallophagan fauna. Scale as in fig. 3.

the Gruiformes and the Charadriiformes is the Rostratulidae (Painted Snipe). This family has an interesting mallophagan fauna: two genera, one (*Quadraceps*) of which belongs to the mallophagan fauna typical of the Charadriiformes (fig. 1) and the other (*Pseudomenopon*) to that of the Rallidae. Little can be deduced from this distribution, the presence of one or other of the genera may be due to secondary infestation. *Pseudomenopon*, it should be noted, is also found on the Gaviiformes and the Colymbiformes.

The Mallophaga of the other five suborders of the Gruiformes are of little assistance in deducing relationships. The Otides (Bustards) have one genus (*Otidoecus*), the nearest relatives of which are found on the Galli (*Cuclotogaster*) and on the Scolopacidae—the snipe and woodcock—(*Rhynonirmus*). These genera are perhaps relics of a previously more widely distributed group of genera. The Mesoenatides (Monias) and the Turnices (Bustard-quails, Hemipodes) are each parasitized by one genus of Mallophaga; these genera are related and probably derived from an ancestral stock widely distributed throughout the Aves, their present day representatives forming the Degeeriellinae found on many unrelated host orders. Although such genera throw little light on the relationships of their hosts it may be mentioned that the genus (*Turnicola*) on the Turnices seems to show affinities to one (*Penenirmus*) on the Passeriformes, the latter also most probably being derived from a *Degeeriella*-like ancestor. This resemblance may be due to parallel evolution or relationship between the hosts, a point of interest as the Turnices show some passerine characters (Lowe, 1923: 277). Only one genus (of doubtful affinities) has been seen from the Eurypygae (Sun-bitterns). The Cariamae (Cariamas) are parasitized by two genera (apart from *Colpocephalum*) found elsewhere only on the Tinamiformes, a distribution probably explained by secondary infestation on the Cariamae. As the Mallophaga of these five suborders are such that no certain deductions can be made as to the relationships of their hosts, there is no object in discussing the ornithological evidence bearing on the affinities of the host groups.

Psittaciformes (Parrots). This order is parasitized by a number of mallophagan genera which throw no light on the relationships of the parrots within the class Aves. The parrots are probably an example of an order on which the Ischnoceran mallophagan fauna is derived from a primitive ancestral stock of a type found throughout the Aves, and which has evolved on the order itself into the different genera now found; these genera will, therefore, be more closely related to each other than to those on any other order.

Cuculiformes One suborder, the Musophagi (Plantain-eaters), has already been discussed under the Galliformes. The other, the Cuculi (Cuckoos) has a quite different mallophagan fauna comprising four genera, one (*Cuculicola*) belonging to the widespread Degeeriellinae, two of which the affinities are obscure, and one other (*Cuculiphilus*), the affinities of which seem to lie with one found on the Falconiformes (see above). The significance of this distribution cannot at the present time be assessed.

Strigiformes (Owls). The owls are parasitized by two genera; the affinities of one (*Strigiphilus*) are unknown, the other (*Kurodia*) is found elsewhere only on the Falconiformes.

Caprimulgiformes (Nightjars) and **Coliiformes** (Colies) are each parasitized by distinctive genera which throw no light on the relationships of the hosts.

Apodiformes, Trogoniformes, Coraciiformes, Piciformes and **Passeriformes.** These orders can be considered together as some members of all the orders are parasitized by elements of the passerine fauna. The order Apodiformes contains two suborders: the Apodi (Swifts), the Mallophaga of which give no evidence as to relationship, and the Trochili (Humming-birds). The latter suborder is parasitized by one genus (or two closely related genera, *Ricinus* and *Trochiloecetes*) found also on the Passeriformes (Perching Birds). Chandler (:379) states that the structure of the feathers shows a striking likeness to those of the latter order. Lowe (1939) basing his conclusions on a study of other anatomical features considered that the humming-birds should be placed as a suborder of the Passeriformes.

The Trogoniformes (Trogons) are parasitized by two genera (*Myrsidea* and *Brüelia*) characteristic of the Passeriformes. Again, Chandler (:378) on the basis of feather structure considered these two orders to be related.

The Coraciiformes (as arranged by Wetmore, 1940) do not have a uniform mallophagan fauna. In the suborder Alcedines the superfamily Alcedinoides (Kingfishers) is parasitized by two genera which throw no light on the affinities of their hosts. No Mallophaga have been seen from the Todoidea (Todies); two genera (*Brüelia* and *Philopterus*) have been taken from the Momotoidea (Motmots) both of which belong to the passerine fauna. In the suborder Meropes (Bee-eaters) one (*Brüelia*) of the three mallophagan genera belongs to the passerine fauna. In the suborder Coracii, the family Coraciidae (Rollers) is parasitized by two genera, one (*Meromenopon*) which is found elsewhere only on the Meropidae, and the other (*Capraiella*) is closely related to one on the Passeriformes (*Picicola*), but is of a generalized type (the Degeeriellinae) found elsewhere in the class Aves. No Mallophaga have been seen from the Leptosomatidae (Cuckoo-rollers). The Upupidae (Hoopoes) have two genera (*Upupicola* and *Menacanthus*) belonging to the passerine fauna, but both belong to groups of genera found elsewhere. The Phoeniculidae (Wood-hoopoes) have two genera, one (*Hopkinsiella*) probably related to *Upupicola* on the Upupidae and the other (*Odoriphila*) the affinities of which are not known. The Bucerotidae (Hornbills) have six genera, none of which belong to the passerine fauna, but the Ischnoceran genera are all probably derived from a single ancestral stock which belonged to the Degeeriellinae, a genus of which is found on the Passeriformes. Chandler shows that in feather structure the Alcedinoidea and the Bucerotes are somewhat different from the rest of the order, a fact supported by the mallophagan faunas which may have evolved in a rather specialized way.

The Piciformes (Jacamars, Barbets, Toucans, Woodpeckers) (with the exception of the Galbuloidea from which nothing has been seen) have an entirely passerine mallophagan fauna[1] which supports the evidence put forward by Chandler and Lowe (1946) based on the morphology of feathers, skeleton and muscles.

The distribution of the Mallophaga on these orders suggests, therefore, a close passerine relationship for the Pici, Trogoniformes and Momotidae, and a less close passerine connection for the Trochili, Meropidae and Rhamphastidae. The Mallophaga of the rest of the groups although not conclusive, do not preclude a passerine relationship, except perhaps in the case of the Alcedinoidea where the Mallophaga show no passerine affinities.

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[1] *Austrophilopterus* from the toucans is not found on the Passeriformes, but like *Picicola* of the latter order is probably derived from a Degeerielline ancestor.

EXPLANATION OF THE DISTRIBUTION CHARTS

As the mallophaga have a host-wise not a geographical distribution the parasitologist has no method of demonstrating distribution graphically. These charts are an attempt to do so. They are based on Wetmore's classification of birds (1940) and the suborders are drawn as entire areas clustered together to form the order; the superfamilies,[1] into which a suborder is divided are shown as contiguous areas. The size of each area is proportional to the number of species (as given by Mayr, 1946) in the division represented. Thus, the size of any area shows the number of species over which a parasite genus is distributed; and the number of distinct areas in an order and the irregularity of outline of an area representing a suborder gives some indication of the diversity of host species parasitized. Both these representations can only be approximate for owing to the difficulties of bird phylogney the relation of the 'territories' to each other is often doubtful; and the size of the 'territories' shown will need adjustment as new species are discovered and as birds now considered as species are relegated to subspecific rank. The names of orders are given in large capitals underlined, suborders in smaller capitals, superfamilies in large lower case letters and families in small lower case letters. Where two numbers are given with a name, the lower is the total number of genera recorded from the host group and the upper is the number of genera belonging to the mallophagan fauna (shown in black) of the order illustrated. The mallophagan fauna is the number of genera characteristic of the host group in question. A genus found on only one small section of the group is not included in the faunal number, but is included in the lower number. *Colpocephalum,* for the reasons given above, is omitted from all the faunal numbers and from both upper and lower numbers. Two genera on one host order which are allopatric replacements of each other are counted as one genus: *Bizarrifrons* and *Sturnidoecus,* for instance, are counted as one genus in compiling the mallophagan fauna of the Passeriformes, as the former genus appears to be the allopatric replacement of *Sturnidoecus* on the Icteridae (Troupials).

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[1] No attempt has been made to show the relationship between superfamilies within a suborder.

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ON THE SHRIKE *LANIUS TEPHRONOTUS* (VIGORS), WITH REMARKS ON THE *ERYTHRONOTUS* AND *TRICOLOR* GROUPS OF *LANIUS SCHACH* LINNE, AND THEIR HYBRIDS.

BY

BISWAMOY BISWAS[1]

(*With a map*)

SYNOPSIS

An attempt is made to analyse and correlate the informations that had been recorded and that is under investigation by the writer, regarding *Lanius tephronotus,* with a view to determining its systematic status. Evidence is given of the fact that both *L. tephronotus* and *L. schach* breed in Kumaon and Garhwal, and that they do not intergrade. The question of type-locality of *L. tephronotus* is also discussed. It is shown that *L. tephronotus* should be considered specifically distinct from *L. schach.* An account of each subspecies of *L. tephronotus* and of the *erythronotus* and the tricolor groups of *L. schach* is given mainly in relation to distinctive characters, measurements, material examined, moult, breeding and range. It is shown with the help of a comprehensive hybrid index that *L. schach erythronotus* and *L. s. tricolor* hybridize in a vast area that includes Uttar Pradesh (the United Provinces), Bihar, Madhya Pradesh (Central Provinces) etc., and that *Collurio nigriceps* Franklin is nothing but one such intermediate bird.

INTRODUCTION

Since the publication of Stuart Baker's Fauna of British India—Birds, Vol. 2 in 1924, there has been some controversy among ornithologists regarding the systematic status of *Collurio tephronotus* Vigors, *C. erythronotus* Vigors and *C. tricolor* Hodgson. Baker (op. cit., pp. 292-298) treated them as three distinct species. He used *nigriceps* Franklin for *tricolor,* and placed *erythronotus* as a race of *Lanius schach.* Whistler and Kinnear 1933: pp. 334-337, put them in two different species—*tricolor* and *nigriceps* as races of *Lanius nastus* Scopoli, and the other two as races of *L. schach.* This arrangement was subsequently followed by the British Museum workers, as well as by Oliveer (1944). Dunajewski (1939) in a critical review, treated *tephronotus* as a distinct species, and *tricolor* and *erythronotus* as races of *L. schach.* The last action was, however, hinted at by Meinertzhagen (1927).

Recently I had the opportunity to examine the excellent collection of birds from India made by Dr. Walter Koelz, deposited in the American Museum of Natural History. I examined the question of *tephronotus-erythronotus-tricolor* afresh with the help of the Koelz material supplemented by the materials of the American Museum of Natural History, Museum of Zoology of the University of Michigan, British Museum (Natural History), and the Zoological Survey of India. In all I examined 375 specimens.

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[1] Now in the Zoological Survey of India, Indian Museum, Calcutta.

I am indebted to the authorities of these institutions for their kind coöperation, and to Dr. Koelz for permitting me to study his collection. I am deeply grateful to Dr. Ernst Mayr for much help and his continued interest in this work.

Measurements:—Only the measurements of birds in fresh or slightly worn plumage are given in this paper.

The bill is measured from the skull.

Lanius tephronotus (Vigors)

Lanius tephronotus must be regarded as a distinct species from *L. schach* (containing *erythronotus*). They both have been found breeding in the same or adjacent places in Kumaon (specimens in Kolez collection!), and not one specimen in the fine series show any sign of intergradation between them, although Ticehurst (1926*a*) said that he had seen all gradations between them in the western Himalayas. The main differences between *tephronotus* and *erythronotus* are the tone of gray, the extent of rufous on the back, and size. The extent of rufous on the back is somewhat variable in *erythronotus*, so that specimens of *erythronotus* in very fresh plumage and with lesser amount of rufous may be mistaken for the extreme examples of the Lahul population of *tephronotus*. I could not find a single 'intermediate' example among the vast material of the British Museum (including Ticehurst's own collection).

In the Himalayas two races of *L. tephronotus* can be recognized: (A): Dark slate-gray, with rufous confined on the upperside to the rump and the upper tail coverts, and with the wing speculum usually absent, or when present very small. It breeds in Garhwal, Kumaon, Tibet eastward to Yunnan.

(B): Comparatively lighter gray than (A) with rufous extending beyond the rump to the hindmost scapulars; wing speculum almost always present. Breeds in Lahul, Spiti, Ladakh and Suru Valley.

It had been customary to treat (A) and (B) together as *L. tephronotus* or *L. schach tephronotus*, until Whistler and Kinnear (op. cit., pp. 336-337) recognized (B) as a subspecies distinct from (A). They applied *tephronotus* to (B) and revived Hodgson's *nipalensis* for (A). This transfer of names however, is unjustified as Mayr (1947) shows. A careful study of Vigors's description shows that in describing *Collurio erythronotus* immediately preceding *C. tephronotus*, he clearly mentioned the presence of a wing speculum, but did not mention anything about it in connection with *tephronotus*. His *tephronotus*, therefore, can be logically interpreted as a bird *without the wing speculum*. Accordingly I retransfer *tephronotus* to (A). For (B) we have *L. tephronotus lahulensis* Koelz; Hodgson's *jounotus*, as suggested by Dunajewski (op. cit., p. 38), cannot be applied, since it is a *nomen nudum*.

Lanius validirostris Ogilive-Grant from Luzon, Phillippines, should, I believe, be best treated as a race of *L. tephronotus*. It differs from the Indian races in its smaller size and in having practically no rufous on the upperside[1].

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[1] Ripley (1949) commenting on this paper while still in the MS stage, considers these two forms to be specifically distinct. However, his arguments do not appear to me to be convincing.

The Indian subspecies of *Lanius tephronotus* therefore stand as follows:

Lanius tephronotus tephronotus (Vigors)

1831. *Collurio tephronotus* Vigors, *Proc. Zool. Soc. London*, p. 43—Himalayas, restricted to Gyantse, Tibet by Baker (*Faun. Brit. India, Birds*, **2** : 297, 1924) corrected as ' Foothills of the Himalayas near Darjeeling, where breeding birds of the Gyantse district may be expected to winter' by Mayr (*J. Bom. Nat. Hist. Soc.*, **47** : 126, 1947).
1837. *Lanius nipalensis* Hodgson, *India Rev.*, **1** : 445—Nepal.
1905. *Lanius lama* Dresser, *Proc. Zool. Soc., London*, p. 55, pl. 5, fig. 1—Tsangpo Tal, Tibet.

Measurements :

	Wing.	Tail.	Bill.	Wing-Tail Index.	Wing-Bill Index.
25♂♂ :	98-106	110-123	21-23	111-121	20·1-23·5
	100·7	*115·5*	*22*	*114·3*	*21·9*
12♀♀ :	97-105	109-116	21-24	110-115	20·3-24
	99·7	*114·8*	*22·1*	*112·4*	*22·2*
3 unsexed :	103-104.5	121	21-22	116	20·4-21

Material examined :—

Tibet: 3 unsexed: Gyantse; Tsangpo Valley (June, Sept.). United Provinces: 7 ♂♂, 3 ♀♀, 1 unsexed: Kumaon: Shankola, Urting, Gunji, Rahlam, Badang, Nagling, Samandiu; Gorakhpur dist.: Nichlaul (Feb., June, July). Nepal: 2 ♂♂, 1 ♀, 1 unsexed (1 ♂, 1 unsexed juv.): Nepal Valley: Thankot, Kathmandu, no locality (Mar., April, no date). Sikkim: 5 ♂♂, 6 unsexed (1 ♂, 5 unsexed juv.): Pembringo Pass, 14,400 ft.; Guatong, 12,800 ft.; Keadom, 7000 ft.; no locality (May, June, July, no date). Bengal: 1 ♂, 4 ♀♀, 2 unsexed (2 unsexed juv.: 2 ♀♀ subad.): Darjeeling dist: Kalimpong; Jalpaiguri dist.: Domohni; 24-Parganas: Bandipur; Calcutta; Dacca dist.: Dacca (Jan., Apr., no date). Assam: 7 ♂♂, 3 ♀♀, 1 unsexed (3 ♂♂ juv.): Lakhimpur dist.: Dibrugarh, Margherita; Cachar dist.: Gunjong; Khasia Hills: Nongpoh (Jan., Mar., Apr., Sept., Oct., Dec.). Burma: 2 ♂♂, 2 ♀♀ (1 ♀ juv.): Chindwin dist.: Tago Hko; Myitkyina dist.: Siniku-Shingaw Road, 700 ft., Gangfang, 5500 ft. (Feb., Dec.). Yunnan: 9 ♂♂, 4 ♀♀ (1 ♂ subad.): Tengyueh, 5000-6000 ft.; Yung Chang Fu, 5500 ft.; Mengtsz; Shweli Valley, 6000-8000 ft.; Lichiang Range, 8500-10,000 ft. (Jan., Mar., Apr., May, June, Aug., Sept., Oct., Dec.). Szechwan: 2 ♂♂ (1 ♂ juv.): Tsao Po (15 miles west of Wenchwon); Lung-un (Apr., Oct.). Kokonur: 1 unsexed juv.: no locality (no date). ' West China ': 1 ♀: no date.

Moult:

There does not seem to be any prenuptial moult in this form. The complete postnuptial moult generally starts in September and may be prolonged up to the end of December. Postjuvenal moult takes place in April.

Breeding:

Specimens with definite breeding data were collected in June and July in Kumaon. In Tibet it breeds between mid-May and July (Baker, 1933: pp. 269-270).

Range:

Garhwal, Kumaon, Tibet eastward to Yunnan and northward to Szechwan and Kokonur. In winter some may come down to the plains of Uttar Pradesh (United Provinces), Bengal, Assam, Burma and Indo-China.

Lanius tephronotus lahulensis Koelz

1933. *Lanius schach tephronotus* (Vig.) Whistler and Kinnear, *J. Bom. Nat. Hist. Soc.*, 36 : 336—Simla-Almora.
1950. *Lanius tephronotus lahulensis* Koelz, *Amer. Mus. Nov.*, no. 1452, p. 7 —Kolung, Lahul, Punjab.
(Type in the American Museum of Natural History).

Measurements:

	Wing	Tail	Bill	Wing-Tail Index	Wing-Bill Index
17 ♂♂:	92-102·5	109-120	19.5-23	115-122·5, 127·5	20·8-23·5
	96·9	*115·8*	*21·3*	*119·5*	*22*
6 ♀♀:	93-96	105-111	21-23	113-117	21·9-24·7
	94·9	*108·8*	*22*	*114·3*	*23·2*

Material examined:

Kashmir: 2 ♂♂: Northern Kashmir: Suru Valley (Sunku, 9600 ft.); Ladakh: Kargil (Paskyum, 9000 ft.) (June, July). Punjab: 17 ♂♂, 8 ♀♀, (2 ♀♀ juv. 1 ♂ subad.): Lahul: Kolung, Sisoo (10,000–10,500 ft.), Kyelang, Gundla (10,000 ft.), Daskar (10,500 ft.), Tandi; Spiti; Shichiling; Kulu Valley: Kulu (May, June, July, Aug., Sept., Dec.).

Moult:

No moulting specimen examined. One worn adult male collected on September 2 shows no sign of moulting.

Breeding:

Breeding specimens were all collected between May 29 and July 26. One female collected on July 6 was incubating, another female collected by the late Hugh Whistler has the following data on the label: 'Breeding over. No eggs in ovary. Incubation patches.'

Range:

Kargil and Suru Valley in Kashmir, Lahul and Spiti in the Punjab, and possibly also Rupshu and adjacent areas in Ladakh and Tibet. In winter comes down to lower altitudes, such as Kulu.

Lanius schach Linné

The rufous-backed and the black-headed shrikes of southeastern Asia should, as Dunjewski (op. cit., pp. 31-32) has already shown, be regarded as members of the same species, since there is complete intergradation between the adjacent forms on the mainland.

The 'rufous'-backed shrikes of India are included in the *erythronotus*-group, and the black-headed shrikes of India, Burma, western China and Siam form the *tricolor*-group.

ERYTHRONOTUS-group

The shrikes of this group have a gray back with variable amount of rufous. Four races are recognized in this group.

Lanius schach erythronotus (Vigors)

1831. *Collurio erythronotus* Vigors, *Proc. Zool. Soc. London*, p. 42—Himalayas, Simla-Almora.
1837. *Lanius superciliosus* Swainson, *Classif. Birds*, 2 : 219, nec *Lanius superciliosus* Latham, 1801.

This race is characterized by its gray head and upper back, gradually changing to rufous on the lower back, rump and upper tail coverts, and usually with a large wing speculum. Fully adult females show a faint tinge of rufous even on the upper back.

Measurements:

	Wing	Tail	Bill	Wing-Tail Index	Wing-Bill Inex
Afghanistan:					
15 ♂♂:	93-99	116-124	20-22·5	119·5 128	20·6-23·2
	96·1	*119·2*	*20·9*	*124·1*	*21·8*
5 ♀♀:	92-95	113-116	20-21·5	121·5-124	21·3-23·4
	93·4	*114·7*	*20·6*	*122·5*	*22·1*
Northwestern India:					
23 ♂♂:	88-97	107-125	19·5-22·5	117-129	21·3-23·7
	92·3	*113·1*	*20·7*	*123·9*	*22·4*
16 ♀♀:	87-95	107-118	19·5-23	119-124	21·7-25·6
		(5 specimens)		(5 specimens)	
	89·9	*111·7*	*20·7*	*121·3*	*23·1*
Southern Bombay:					
8 ♂♂:	94-98	113-127	19-21·5	118-130	19·6-22·4
	95·5	*116·7*	*20·7*	*122·3*	*21·7*
9 ♀♀:	88·5-95	108-118·5	19·21	117-126	20·2-23·4
		(6 specimens)		(6 specimens)	
	91·5	*110·9*	*20*	*121*	*22*

Material examined:

Afghanistan: 20 ♂♂, 5 ♀♀, 1 unsexed (3 ♂♂, 1 unsexed juv.): Paghman, Gulbahar, Kabul, Gumandru, Tagau, Ishpi, Khanabad, Tolikhan, Gumbaz, Takia, Puli Komri, Jalalabad (May, June, July, Nov., Dec.). North-West Frontier Province: 1 ♂, 1 ♀: Kurram dist.: Parachinar (May). Kashmir: 2 ♂♂, 7 ♀♀ (1♂, 3 ♀♀ juv., 1 ♀ subad.): Gilgit: Gilgit; Baltistan; Shigar; Ladakh: Shyok Valley, Kampuk; West Kashmir: Bandipura (Apr., June, July, Aug., Sept.). Punjab: 21 ♂♂, 16 ♀♀, (1 ♀ subad.): Kulu Valley: Kakinal, Seobagh Nulla, Naggar; Kangra Valley: Kotla, Bhadwar; Patiala: Patiala; Gurudaspur dist.: Pathankot (Jan., Mar., Apr., June, Nov., Dec.). United Provinces: 2 ♀♀: Lucknow (Dec.). Bombay: 7 ♂♂, 10 ♀♀: Surat dist.: Surat: Belgaum dist.: Londa; Dhawar dist: Hubli (Jan., Feb., Mar.).

Moult:

There is a complete postnuptial moult which may start as early as August 19 (1 ♀, Baltistan). Almost all specimens taken in December, January and February are in very fresh plumage; of March and April birds a few are worn.

Breeding:

Generally it breeds in May-June. All the fledglings I have seen were collected between mid-July and September.

Range:

Afghanistan, North-West Frontier Province, Kashmir and the Punjab Hills. In winter to the plains of India as far south as southern Bombay and Hyderabad. Ticehurst (1926) and Baker (1933: p. 265) doubted Osmaston's (1925, 1927) breeding record of this race in Kargil (Ladakh). However, I examined a subadult female from Shyok Valley, Ladakh, collected by W. Koelz on September 8, and it seems possible that it breeds there.

Lanius schach jaxartensis Buturlin

1911. *Lanius erythronotus jaxartensis* Buturlin. *Mess. Orn.*, 2:144 – Syr-Daria, Transcaspia.

This Transcaspian race is said to differ from *L. s. erythronotus* in being larger: wing, 93-110; tail, 110-122. Many ornithologists do not recognize this race.

I have not seen any example of this form.

Lanius schach kathiawarensis Koelz

1950. *Lanius schach kathiawarensis* Koelz, *Amer. Mus. Nov.*, No. 1452, p. 7—Jamwala, Junagarh, Kathiawar.
(Type in the American Museum of Natural History)

This race differs from other races of the *erythronotus*-group in having the gray on the upperside palest, and the rufous less in extent than in *erythronotus* but more than in *caniceps*.

Measurements:

	Wing	Tail	Bill	Wing-Tail Index	Wing-Bill Index
8 ♂♂:	88-92	110-120	20-21	122·5-133	21·8-23.4
	90·6	*115·5*	*20·4*	*128·3*	*22·5*
5 ♀♀:	88-90	108-113	20-21	122·5-127	22·7-23·4
	89	*111·1*	*30·5*	*124·9*	*23·1*

Another female is very large, it measures :

	94	*126*	*20·5*	*134*	*21·8*

Material examined:

Sind : 1 ♂, 2 ♀♀ (1 ♂ subad.) : Khinjar Lake (Jan., Feb.). Rajputana : 7♂♂, 4 ♀♀ (1 ♂ juv.): Mewar : Udaipur, Barapal ; Sirohi : Oria, Sirohi (Jan., Apr., Oct., Dec.). Kathiawar: 3 ♂♂, 3 ♀♀ (1 ♀ juv.): Sihor ; Junagarh : Jamwala (Jan., Feb.).

Moult:

No moulting specimen examined.

Breeding:

No breeding specimen examined. In Sind, Ticehurst (1922) said that they breed between March and June, and that at least three broods are reared in the season.

Range:

Sind, Rajputana (possibly also Kutch) and Kathiawar.

Lanius schach caniceps Blyth

(Type in the Zoological Survey of India)

1846. *Lanius caniceps* Blyth, *J. Asiat. Soc. Bengal*, 15: 302—[= Madras area, according to Kinnear and Whistler, *J. Bombay. Nat. Hist. Soc.*, 34: 396, 1930].
1878. *Lanius affinis* Legge, *Str. Feath.*, 4:243—Ceylon.

Among the races of the *erythronotus*-group, *caniceps* has the least amount of rufous on the back; it is generally restricted to the rump and the upper tail coverts, sometimes extending a little anteriorly to about the hindmost scapulars. The tone of gray on the back is more or less similar to that of *erythronotus*.

Measurements :

	Wing	Tail	Bill	Wing-Tail Index	Wing-Bill Index
10 ♂♂ :	88-93	109-125	20-22	124-132	22·2-25
	90·9	*117·1*	*21·1*	*128·5*	*23·3*
6 ♀♀ :	86-93	110-119	20-22	122·5-134	21·5-25·1
	89·8	*115*	*20·9*	*129·8*	*23·2*

Material examined:

Madras : 10 ♂♂, 5 ♀♀, 1 unsexed : Bellary district : Hospet ; Cuddapah dist.. Sidhout, Kodur; South Arcot dist. : Cuddalore ; Malabar dist.: Nilambur ; Nilgiris : Ootacamund ; Madura dist. : Palni Hills (Kodaikanal) (Feb., Mar., Oct.,); Mysore : 1 ♂, 1 unsexed: Mysore dist. ; Bangalore dist. : Satnur (Nov., Dec.). Ceylon : 2 ♂♂, 1 ♀ : Aripo (Feb., Mar., Nov.)

Moult:

One specimen collected in Mysore district on November 20 has the body moult almost finished; wings and tail still in moult.

Breeding:

The only specimens with definite breeding data I examined are from the Nilgiris, February 16, 17, Nilambur (Malabar), March 3, and Kodaikanal (Palni Hills), March 10. Baker (1924: p. 297) gives February and March as the breeding season in Travancore, and May to July in 'Deccan.' In Ceylon, according to Whistler (1944), it breeds between February and June.

Range:

Northwestern Ceylon, southern India as far north as Bellary in the centre and Cuddapah on the east, and on the west side northward to Malabar.

TRICOLOR-group

The shrikes of this group are characterized by a black head, chestnut back, and long tail.

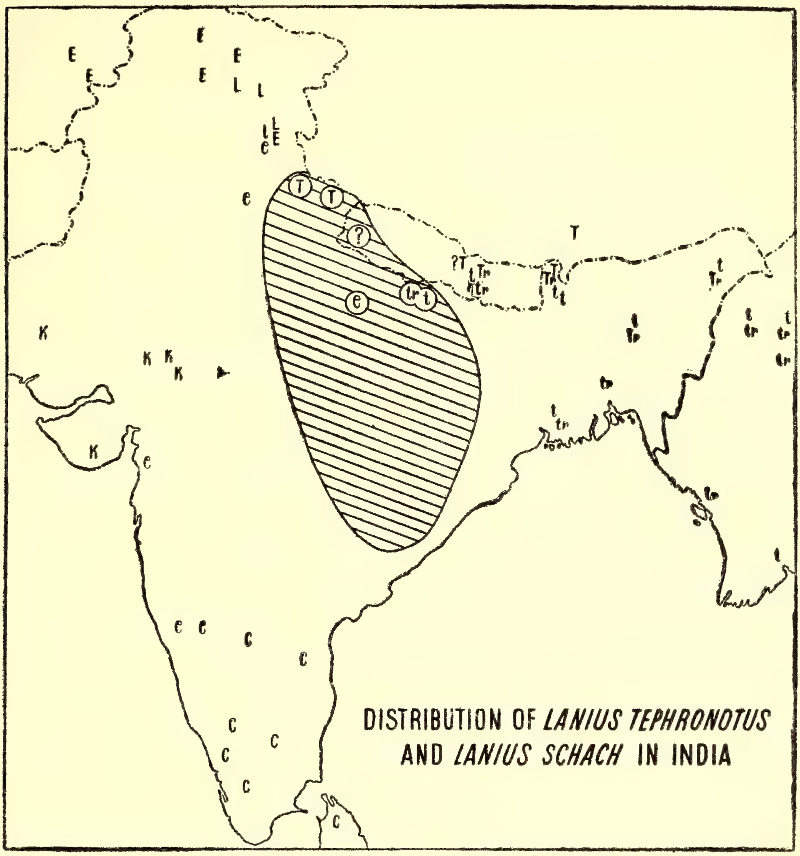
Two subspecies are recognized in this group:

Lanius schach longicaudatus Ogilvie-Grant

1902. *Lanius nigriceps* subsp. *longicaudatus* Ogilve-Grant, *Nov. Zool.*, 9 480—Siam, Bangkok.

1940. *Lanius nasutus schomburgki* Kinnear, *Ibis*, (14) 4 : 728-729. New name for *Lanius nigriceps longicaudatus* Ogilvie-Grant—not admissible for Gadow's (*Cat. Birds Brit. Mus.*, 13 : 262) citation of *longicaudatus* as a synonym of *Lanius schach* being due to misidentification, does not invalidate the further use of *longicaudatus* Ogilvie-Grant.

This race differs from the allied *tricolor* by its very long tail: 130-155, against 115-135.



DISTRIBUTION OF *LANIUS TEPHRONOTUS* AND *LANIUS SCHACH* IN INDIA

T,	*Lanius tephronotus tephronotus*	**K,**	*Lanius schach kathiawarensis*
t,	,, ,, ,, (winter)	**C,**	,, ,, *caniceps*
L,	,, ,, *lahulensis*	**Tr,**	,, ,, tricolor
l,	,, ,, ,, (winter)	**tr,**	,, ,, ,, (winter)
E,	,, *schach erythronotus*		Zone of hybridization between *L. s. erythronotus* and *L. s. tricolor* is shaded.
e,	,, ,, ,, (winter)		

Measurements:

	Wing	Tail	Bill	Wing-Tail Index	Wing-Bill Index
2 ♂♂:	96-98	145-156	22-23	151-159	22·9-23·5
2 ♀♀:	96-99	———	22·5-23	———	23·3-23·4

Material examined:

Siam: 2 ♂♂, 2 ♀♀: Bangkok, Rat Buri (Jan., Apr., June)

Range:

From Amherst in Tenasserim (Burma) southward to southwest and peninsular Siam.

Lanius schach tricolor (Hodgson)

1837. ***Collurio tricolor*** Hodgson. *India Rev.*, 1: 446 – Nepal, hereby restricted to Kathmandu, Nepal Valley.

This is the shorter-tailed black-headed shrike. The chestnut on the back is generally deeper and the wing speculum smaller than in *longicaudatus*.

Measurements:

Uttar Pradesh and Nepal:

	Wing	Tail	Bill	Wing-Tail Index	Wing-Bill Index
9 ♂♂:	93-98	115-127	20·5-23	120·5-131	21·8-23·7
	95·8	*120·7*	*21·7*	*127·3*	*22·8*
5 ♀♀:	93-96	112-123	20-22	117-131	21·5-22·9
	94·2	*119*	*21·1*	*126·3*	*22·4*
1 unsexed:	96	———	22·5	———	23·4

Sikkim, Bengal, east to Yunnan:

	Wing	Tail	Bill	Wing-Tail Index	Wing-Bill Index
8 ♂♂:	94-101	124-135	21-22·5	126-135	21·5-23·2
	97.4	*129*	*21.8*	*131·1*	*22·3*
6 ♀♀:	93·5-96	119-126	20-23	125-132	22·9-24·7
	94·9	*122*	*21·8*	*129·3*	*23·7*
3 unsexed:	93-97	120-127	22-23·5	126-132	22·7-24·5

Material examined:

United Provinces: 2 ♂♂: Gorakhpur dist.: Nichlaul (Feb.). Nepal: 8 ♂♂, 7 ♀♀, 1 unsexed: Nepal Valley: Thankot (nr. Kathmandu); Lower Hills: Bhimphedi (Mar., Apr.). Sikkim: 2 unsexed: Teesta Valley, 4500–5000 ft. (Dec.). Bengal: 2 ♀♀, 1 unsexed: Darjeeling dist.: Darjeeling; Dacca dist.: Dacca (Jan. no date). Assam: 6 ♂♂, 4 ♂♂, 1 unsexed (2 ♂♂, 2 ♀♀ juv.): Lakhimpur dist., Dibrugarh, Margherita; Khasia Hills: Barapani (May, June, July, Aug., no date).

Moult:

Several specimens in various stages of postnuptial moult, which is complete, have been examined, the earliest taken on July 26 at Dibrugarh (Assam), and the latest on December 24 at Shweli Valley (Yunnan). The Dibrugarh bird has its body moult finished but the wing and the tail are still old and worn. The November and December specimens have their body and wing moult finished but the tail is still in moult. All birds taken in February, March and April are in very fresh plumage. Whether they have any spring moult is uncertain, as I have not seen any specimen actually moulting.

Breeding:

It generally breeds in April-May, but I saw it breeding in Nepal Valley as early as March 24, and Scully (1879) took eggs on June 14.

Range:

Mountains of Nepal eastward through northern Burma to Yunnan. In winter some birds come down to the plains of the Uttar Pradesh, Nepal, Bihar, Bengal, Burma, Siam and Indo-China.

HYBRIDIZATION BETWEEN *Lanius schach tricolor* AND *Lanius schach erythronotus*

As early as 1846, Blyth (*J. Asiat. Soc. Bengal,* 15: 303) mentioned a specimen of shrike collected at Benares by Lord Hay as having 'the cap mingled fuscous and ashy, and the forehead above deep black. . .' He considered it to be a hybrid between *erythronotus* and *tricolor* (olim *nigriceps*). Then again, Ogilvie-Grant (*Nov. Zool.,* 9: 479, 1902) said :

> 'The amount of grey on the back [of *tricolor*] appears to be due to locality ; for we find all the fully adult birds from Raipur, in the Central Provinces, and from Mirzapur, in the North-Western Provinces, with the grey on the upper back much developed and of a pale colour, indicating, in our opinion, an approach towards *L. erythronotus.* From North-Western India we have also a number of birds which are obviously intermediate between *L. nigriceps* [=present *tricolor*] and *L. erythronotus,* and may be considered by some as hybrids.'

Dunajewski (*op.cit.*, pp. 41-42) discussed this hybridization between *erythronotus* and *tricolor*, giving examples of the same material as Ogilve-Grant's. In the meantime, Whistler and Kinnear (1933: p. 335), finding some breeding specimens with black head and gray back from the northern part of the Eastern Ghats, restricted Franklin's *nigriceps* for the birds of the central part of the Indian peninsula, reviving Hodgson's *tricolor* for the birds of the northern breeding range.

The large material, I have been able to examine, from Garhwal, Kumaon, plains of Uttar Pradesh (the United Provinces), Bihar and Madhya Pradesh (Central Provinces), clearly shows that there is a complete intergradation between *tricolor* and *erythronotus* in this vast area. Intergradation practically starts at Nepal Valley. I examined 16 specimens from the Nepal Valley and the lower hills due south of the Valley ; only one of them has a gray head with a small amount of black, and the other birds are all fully blackheaded, but in size these birds are slightly smaller than more eastern birds. Unfortunately, the type locality of *tricolor* is Nepal. In this hybridizing zone (see map) the breeding birds show all shades from gray to black on the head, from pale rufous to chestnut on the back, and have short to long tail. A perusal of the following Hybrid Index, made only from examples collected in the breeding season, will make the issue quite clear.

HYBRID INDEX

A, colour of the head: black as in *tricolor* = 40; gray as in *erythronotus* = 0

B, gray on back: inconspicuous band as in *tricolor* = 20; extensive as in *erythronotus* = 0.

C, red on back: chestnut as in *tricolor* = 10; rufous as in *erythronotus* = 0.

D, length of tail: 133-135mm. = 10; below 106 mm. = 0.

E, wing-tail index: 135 = 10; below 117 = 0.

F, distance between the tips of the outermost and the innermost rectrices: 49-50mm. = 10; below 31mm. = 0.

For several specimens the value of certain characters could not be ascertained owing to specimens being in imperfect condition. For them the totals are, however, brought upto 100, and are placed in parentheses.

LOCALITY	A	B	C	D	E	F	TOTAL
Males:							
Afghanistan, Paghman	0	0	0	4	5	5	14
Paghman	0	0	0	6	5	7	18
Gulbahar	0	0	0	4	2	5	11
Kabul	0	0	0	7	5	6	18
Gumandru	0	0	0	5	5	5	15
,,	0	0	0	6	6	5	17
,,	0	0	0	5	4	—	(10)
Tagau	0	0	0	4	3	6	13
,,	0	0	0	5	3	4	12
Ishpi	0	0	0	5	5	4	14
Kashmir, Gilgit	0	0	4	1	1	1	7
North-West Frontier Prov., Parachinar	0	0	1	—	—	—	(1)
Punjab, Kulu, Kulu	0	0	2	—	—	—	(3)
Kangra, Bhadwar	0	0	0	3	2	4	9
,,	0	2	0	1	1	2	6
,,	0	0	0	2	5	3	10
,,	0	0	3	1	2	1	7
,,	0	0	0	2	2	3	7
Uttar Pradesh—							
(United Provinces) Garhwal, Deopal	0	0	3	3	4	6	16
Kumaon, Bhim Tal	0	0	4	—	—	—	(6)
Someshwar	2	0	0	3	4	7	16
,,	8	0	3	6	7	7	31
Bageshwar	0	0	7	6	8	6	27
Patori	16	0	5	—	—	—	(30)
,,	38	10	3	5	6	—	(69)
Bui	10	0	2	5	—	5	(24)
Bona	32	10	10	6	7	—	(72)
Budi	14	0	5	—	—	—	(27)
Sirka	24	10	8	—	—	—	(60)
Bihar, Palamau, Mahammadganj	40	12	8	—	—	—	(86)
,,	36	0	1	—	—	—	(53)
,,	40	5	1	—	—	—	(66)
,,	40	5	4	—	—	—	(70)
Madhya Pradesh—							
(Central Provinces) Mandla, Bichhia	40	10	2	—	—	—	(74)
,,	17	10	4	—	—	—	(44)
,,	40	0	8	3	6	—	(63)
,,	40	10	6	4	7	7	74
,,	40	5	5	—	—	—	(71)
Belwani-Kisli	1	0	—	—	—	—	(1)
,,	5	5	6	—	—	—	(23)

LOCALITY		A	B	C	D	E	F	TOTAL
Nepal Valley, Thankot	...	40	18	10	6	5	9	88
Yunnan, Tengyueh	...	40	20	10	8	7	7	92
Lichiang Range	...	40	10	4	7	5	6	72
Females:								
Afghanistan, Ishpi	...	0	0	0	4	4	6	16
Paghman	...	0	0	0	4	3	5	12
Khanabad	...	0	0	0	3	3	8	14
Kashmir, Bandipura	...	0	0	2	—	—	—	(3)
North-West Frontier Prov. Parachinar	...	0	0	2	—	—	—	(3)
Punjab, Kulu, Kulu	...	0	0	0	—	—	—	(0)
,,	...	0	1	0	—	—	—	(1)
Naggar	...	0	0	0	—	—	—	(0)
Kakinal	...	0	0	0	—	—	—	(0)
Kangra, Bhadwar	...	0	0	0	—	—	—	(0)
Uttar Pradesh— (United Provinces) Kumaon, Kapkot	..	6	0	5	1	2	—	(16)
Naini Tal	...	6	12	4	1	2	4	29
,,	...	2	6	3	2	2	4	19
Bui	...	6	0	5	—	—	—	(16)
Bona	...	2	0	4	—	—	—	(9)
Shankola	...	28	16	3	—	—	—	(67)
Balukot	...	20	3	2	—	—	—	(36)
Samandiu	...	4	—	—	—	—	—	(10)
Bihar, Palamau, Mahammadganj	...	40	5	3	—	—	—	(69)
,,	...	37	5	4	—	—	—	(66)
,,	...	18	16	3	—	—	—	(53)
,,	...	2	20	10	—	—	—	(46)
Madhya Pradesh— (Central Provinces) Jubbulpore, Bheraghat	...	4	15	4	1	5	3	22
Mandla, Bichhia	...	12	14	10	—	—	—	(51)
,,	...	38	2	8	3	5	6	72
,,	...	39	14	8	2	5	—	(76)
,,	..	40	18	2	—	—	—	(86)
Kanha	...	30	0	2	—	—	—	(46)
Nepal Valley, Thankot	...	40	19	3	3	1	3	69
,,	...	40	18	3	6	6	6	79
Assam, Lakimpur, Margherita	...	40	18	10	5	8	—	(90)
Yunnan, Tengyueh	...	40	18	8	—	—	—	(91)

Summary:

		A	B	C	D	E	F	TOTAL
L. s. erythronotus: Afghanistan—Punjab.	♂♂:	0	0–2	0–4	1–7	1–6	1–7	(1)–18
	♀♀:	0	0–1	0–2	3–4	3–4	5–8	(0)–16
Intermediate populations: Uttar Pradesh (United Provinces) Bihar and Madhya Pradesh (Central Provinces.)	♂♂:	0–40	0–12	0–10	1–6	2–8	3–7	(2)–(86)
	♀♀:	2–40	0–20	2–10	1–3	2–5	3-6	(9)–(86
L. s tricolor: Nepal—Yunnan.	♂♂:	40	10–20	4–10	6–8	5–7	6–9	72–92
	♀♀:	40	18-19	3–10	3–6	1–6	3-6	69–(91)

These intermediate birds generally breed between May and July. All the fledgings were collected between June 26 and September 4. Young birds collected later are somewhat advanced. The coloration of the young birds and some data on their labels give additional evidence of hybridization between *erythronotus* and *tricolor.* Thus, some of the fledglings match well with those of *erythronotus,* some with those of *tricolor,* and some show mixed characters such as, no black on the head but deep rusty back, or the head mixed black and gray, but light rufous lower back. One fledgling (Bona, Kumaon, ♂, June 30) has on its label: 'Accompanied by adult *L. nigriceps.*' Another such bird (Bichhia, Central Provinces, ♂, July 16) has: 'Being fed by black-headed bird.'

It would appear that Franklin's *Collurio nigriceps* was described from example(s) of such hybrid populations having black head and gray back.

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THE GIR FOREST AND ITS LIONS

BY

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KUMAR SHREE DHARMAKUMARSINHJI

Part II

(*With a plate*)

(*Continued from page* 514 *of Volume* 48)

1. THE TEST COUNT (M.A. W-B.)

Although delays and difficulties made it impossible to hold the census in April 1949 as I had hoped, sanction (and finance) was finally accorded in December, mainly through the efforts of the Revenue Minister, Mr. Samaldas Gandhi. The future working of the scheme was further simplified by the appointment of my friend, and member of the Society, K. S. Banesinhji, as Collector of Junagadh.

Consequently December 26th saw us once again driving from Junagadh to Jamwala in the same old Ford V8. Our journey proceeded smoothly (in a strictly metaphorical sense) until we attempted to cross the Singavada at Budheshwar temple close to Jamwala. Here the river was deeper than we foresaw and we found ourselves stranded in mid-stream with water flooding over the floor. An amphibious operation rescued Prudence (our small daughter whom we were introducing to the Gir Forest) and we settled down to await the arrival of the salvage party. This came within the hour, 15 strong and with two bullocks and hauling tackle. The car was heaved through the river and we reached Jamwala without further incident in time for a late tea.

That there were considerably more lions around Jamwala than there had been the previous year soon became obvious. As the year had been one of good rains there were many less cattle in the forest, with the natural result that lions were hanging around the border villages seeking what they might devour. In addition, a large number of the forest nesses had been closed on suspicion of harbouring and helping dacoits.

As early as the evening of the first day after our arrival a pair of lions obligingly killed a large buffalo only five hundred yards away from the rest house. When we went along to have a look at them at 10.00 p.m., our party, perhaps fifteen strong, had no difficulty in driving them off their kill. We then settled ourselves behind a scrubby growth of *Zizyphus nummulata,* that particularly thorny species of *bor,* exactly eight yards from the kill, and waited for something to happen. Within three minutes we heard a soft but heavy pad . . pad . . pad, followed by the sound of gnawing, just the sound of a large dog gnawing a bone. Having allowed this to continue for a minute or two, we sprang up and flashed our torches on the scene. The disturbed lioness (for it was only she) gave us a brief glance of annoyance before making off to join her mate forty yards away among the trees. And there they remained until we left half an hour later.

The following day a beat was arranged for the purpose of taking a photograph, but once again this was not a success, for, although on this occasion we were ensconced in the safety of a *Sterculia* tree with a fine view all around, the moment the lion appeared, Mr. Bhatt, the A.F.O., who did not seem to have the simple trust in lions which everyone else displayed, called out quite loudly and clearly 'Halt'. The lion obeyed like a guardsman, immediately spotted Mr. Bhatt, and, the dislike apparently being mutual, broke to the left at top speed through the line of beaters, and neither he nor his mate were seen any more.

Nor was this the end of our excitements, for having had a close view of two lionesses the next day, in the early hours of the following morning a pair of lions raided the village, bursting into a flimsy hut right at its centre that contained two cows and three calves. Roused by the commotion the villagers drove the lions from the hut, but not before a calf had been killed and a cow mauled. One lion broke out on the opposite side from which he had entered, bounded over a seven foot wall and made for the river: from the other side burst the wounded cow which rushed down the village street closely followed by the second lion, pursued in his turn by the enraged villagers. The cow finally charged and broke a stout wooden door in an attempt to gain the sanctuary of a safe courtyard in which she ordinarily lived: the lion continued down the road in the direction of the railway station.

When we examined the cow in the light of day, although she was looking very sorry for herself, the damage suffered was mainly to her nervous system, for she had escaped lightly with one or two gashes on both sides of her neck, injuries very similar to those I had seen on the neck of a mauled cow in the near-by village of Kansaria. The latter had been saved by a herd of buffaloes standing close by, which had charged the lion and driven him away.

The main object of this visit to the Gir was to hold a test count of lions over some small area to give us very necessary experience before planning and working the April census. The area chosen was the southern 2/3 of the Jamwala Division, a tract of about 110 sq. miles. As the methods, with a few modifications, were much the same as those employed in the census held four months later, it is unnecessary to go into the details of its working at this point.

This test count turned out to be an extremely satisfactory operation. As it was held over a relatively small area we were able to supervise it very thoroughly, and the encouraging and important facts to emerge were the reliability of the supervisors and enumerators, and the whole-hearted interest and co-operation of everyone concerned. Had I not been convinced of the former it would, of course, have been futile to attempt to hold the census.

We had early evidence that the total tally would be greater than I had expected, for on our tour of inspection on December 31st, the day previous to the count (a day devoted to cancelling out old pugmarks), between us we discovered eight different sets of fresh pugmarks without going very far from headquarters.

I was therefore not surprised when the final total worked out at 42.

The day of the count ended in personal disaster, for having toured through Bhaka and Thordi checking up pug-marks and finding everything in order, we continued over a road of the most appalling description to Banej Nes and thence in the direction of Chhodawadi, until a pothole proved the final undoing of Junagadh State Car 37. There was a sharp report and the fore portion of the old warrior settled ominously onto her front wheels. After inspection our driver announced with great satisfaction, for he was a confirmed pessimist, that both centre bolts, front and back, were smashed. We staggered on as far as Chhodawadi where he set about the task of making temporary repairs. These he told us, with almost fiendish glee (he had always been prophesying that some such disaster was inevitable on the roads over which we had been travelling), would take three hours.

Not wishing to be benighted in the jungle I decided to walk back to Jamwala, feeling quite sure I should cover the 11 miles before the arrival of those I was leaving behind — — they viewed the prospect of walking with more than disfavour. I should also be able to send out a rescue party and allay alarm in those who had been left at home.

The car, after all, was ready in two hours, but finally broke down at Dhabala, and its occupants then had to walk whether they liked it or not.

I arrived just after dark after a pleasant stroll in the cool of the evening. Conscience had compelled Nur Mahommed to accompany me and between us we had found the pug-marks of no less than six different panthers, an interesting sidelight on the abundance of this animal in the Jamwala forests.

Results of the Test Count held in the southern 2/3 of the Jamwala Division on January 1st 1950

Centre	Lions	Lionesses	Young	Total
Janwadla	5	3	0	8
Jamwala	11	5	1	17
Thordi	3	3	3	9
Jhankia	4	2	2	8
Totals ...	23	13	6	42

* * * *

2. THE CENSUS (M.A. W-B. & K.S.D.)

a. Methods.

It should not be thought that this lion census was undertaken lightly, for it was the culmination of eight weeks' field work and twenty months' intermittent research.

The census was based on three factors: that lions must drink at least once in the twenty-four hours; that they travel for preference along roads and paths; and that the pug measurements of two lions are seldom identical.

If the drinking places were limited in number, and the ground at them always suitable for the reception of pug-marks, there would be no need to search further afield. But this is far from the case as there is much water in the forest, and its edges are often rocky, grass-covered or of coarse shingle. The roads and paths, are, on the contrary, at the season chosen for the census (end of April), covered with a fine dust, a perfect medium for recording pug-marks. Therefore if a search is made wherever there is water, and over a judicious selection of roads and paths (more concentrated attention being paid to areas most favoured by lions), with absolutely exact enumeration the pug-marks of practically every lion should be found. Even if lions do not travel along paths or roads they are reasonably certain to cross them and will so enter into the count.

However, as perfection can hardly be expected, the count was held on two consecutive days, the second day being relied upon to produce the majority of lions which had escaped enumeration on the first day.

In the Baroda territory enumeration also took place on the third day, with satisfactory results, as this is an area relatively sparsely inhabited by lions. In areas thickly populated with the animals a third count would probably defeat its own ends owing to the difficulty of sorting out the large mass of information so collected.

The success of the census naturally depended on the accurate measurement of the pug-marks, and more attention was paid to impressing on supervisors and enumerators the method of measurement and need for accuracy in it, both by aid of diagrams and by examples in the field, than to anything else in the census.

The measurements taken were the length and breadth of the pug-mark of the forefoot — — that is the length and breadth of a rectangle exactly fitting its outermost extremes.

Careful examination of large numbers of pug-marks had shown me that the figures so produced, whilst constant in individual lions (provided the measurements were not taken on an unsuitable surface), were remarkably variable between different lions.

The measurements were taken with specially prepared sticks, red for the first day, blue for the second (red, blue and white in Baroda), broken to the correct measurement.

The census covered an area of between 700 and 800 square miles, including the whole of the Gir Forest and the revenue areas at its edges where lions might be expected to roam. It was probably the biggest operation of its kind ever undertaken.

The whole tract was divided into 5 divisions:—Jamwala, Jasadhar, Visavadar, Baroda and Sasan. Sasan, being of unwieldy size was subdivided into three circles: Alawani, Sasan and Andhania-Talala-Devalia. The Assistant Forest Officers of the divisions (the Sub-Divisional Forest Officer in Baroda) were responsible for dividing their divisions into smaller units, or centres, and in co-operation with the supervisor of each centre for appointing enumerators and allotting to them their beats.

The small forest area of Mytiala, beyond the eastern limits of the Gir, was left to the care of the Grass Officer, Gohelwad. The overall organisation was M. A. Wynter-Blyth's.

The management of the Sasan-Visavadar sector was in the hands of K. S. Dharmakumarsinhji of Bhavnagar and Yuvraj Shree

Pratapsinhji of Wankaner (both members of the B.N.H.S.): Baroda in the hands of Mr. Shah, sub-D.F.O., Amreli: Jamwala-Jasadhar in the hands of Major Dubois and myself.

Our duties were to see that the scheme was carried out according to plan, to visit all the centres, to check as much work as possible in the field—in short, to appear as often as possible in as many places as possible.

The following instructions were issued in writing to all supervisors, together with a diagram showing the method of measuring pug-marks:

1. Supervisors must see that enumerators know the beats allotted to them and that they understand exactly the method of measurement of pug-marks. They must explain the latter to every enumerator personally both by aid of the attached diagram and by practical demonstration. They must impress on enumerators the need for accuracy in making these measurements.

2. Red sticks will be used for the first day; blue sticks for the second. The pug-mark of the forefoot will be measured.

3. Enumerators must remember the exact locality in which they found pug-marks, whether lions were moving singly, in pairs and so on. They must also collect lion *khabar* from *maldharis* and others.

4. Unless unavoidable, pug-marks must not be measured in coarse sand or shingle. If they are measured in such surfaces the fact must be reported to the supervisor.

5. Enumerators must report at their centres at daybreak on April 27th, and devote the morning of that day until noon to searching for and cancelling out old pug-marks. Counting will take place from dawn until noon on both the 28th and 29th. On the 28th pug-marks must again be cancelled out to eliminate any risk of their being counted a second time on the 29th.

6. Enumerators should work in pairs. Men on daily wages (unless known to be very experienced in the jungle) should, wherever practicable, be paired with a beat guard.

7. Measurement sticks are to be brought to the centres as soon as possible after noon on each day of the census and handed to the supervisor who will label each pair of sticks with the information required under heads 3 and 4.

8. Bundles of sticks will either be collected at the centres or brought to the divisional headquarters by the supervisors, whichever is considered advisable.

9. Jasadhar and Baroda Divisions only. Enumerators are, in addition, to estimate the sex of the lions whose pug-marks they find.

After the sticks had been collected I measured them and entered the figures and all relevant information on two series of maps, one for each day. From the data so produced I eliminated every second, third or more enumeration of the same lion on the one day, at the same time including in the final total all lions that had appeared on only one of the two days. The final total, therefore, was made up of lions that had appeared on both days and lions that had been counted only once.

For example: Let it be supposed that division X, after the preliminary processes of elimination had been completed, had produced 25 lions on the first day and 28 lions on the second. Of these, 20 lions were found to be common to both days, 8 new lions had appeared on the second day but on that day 5 lions that had been enumerated, on the first day were not found. Total count: 33 (subject to a cross-check with adjacent divisions).

A lion might have been counted twice by one enumerator, or in more than one beat, centre or even division. Any pug-marks with similar measurements found within a radius of at least five or six miles were suspect, and, unless I had grounds for allaying these suspicions, only one of them was counted, but, naturally enough, a certain latitude in measurement had to be allowed.

In many instances other data assisted in the decision. For instance, whether lions were travelling singly, in pairs or in larger groups, whether the pug-marks were those of a lioness with cubs, and (Jasadhar and Baroda only) the sex of the animals, though, as will be seen later, estimation of sex by pug-marks is subject to error.

Any 'cubs' found unaccompanied by grown lions were eliminated (unless the pug-marks had been seen by ourselves) on suspicion of being panthers.

In the second day's count the majority of lions that had appeared on the first day could be identified without much difficulty, generally near where they had been found the day before, seldom more than four or five miles away.

An interesting point is that had I divided the gross total of sticks as they were handed in to me by two, the result would have been precisely one less than my final total after the arduous and complicated process of elimination and inclusion!

b. Results.

Lion Census held on April 28th and 29th, 1950

Division		Grown Lions	Young Lions	Totals
Jamwala[1] ...		39	6	45
Visavadar ...		19	5	24
Sasan				
(Alawani Circle ...		12	4	16
Sasan Circle ...		14	4	18
A.T.D. Circle ...		24	10	34)
Totals for Sasan ...		50	18	68
	Males	Females		
Baroda	19	5	3	27
Jasadhar	23	14	8	45
Mytiala	1	nil.	nil.	1
Totals counted ...		170 grown lions	40 young lions	210
Girnar ...		3 lions		3
Hill of Sana ...		6 to 14 lions		6 to 14

Final total 219 to 227 lions.

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[1] In proportion these figures are considerably smaller than those recorded in the Test Count. This is due to a large forest fire that occurred just before the census, driving much of the game out of the division.

Notes on the above table

(*a*) *Girnar lions.*

These lions were not counted and the figures are based on reports, but there is little doubt that three lions were resident in the Girnar at the time of the census. It is likely that lions would permanently repopulate these jungles if allowed to do so.

(*b*) Hill of Sana lions[1].

On arrival at Sasan we were assailed by rumours of large numbers of lions wandering about in the revenue areas, often some distance from the forest. However, in point of fact the census recorded very few lions indeed from such areas (except from Talala Mahal where, as it is semi-forest, they are resident) and, with one exception, none at all far away from the forest boundaries.

The truth of the matter is, I fancy, that lions have recently been making occasional sorties at night some distance into the revenue lands, returning to the forest early the next morning. As such lions appear in places where they are not normally seen at this season, considerable fuss is made about them and the reports are exaggerated.

The exception to the above was the pride of lions resident (at least temporarily) at the Hill of Sana, an area not included in the census as it had been considered too far from the forest to contain any lions.

Whilst at Jasadhar on the 26th we heard rumours of a pride of 11 to 13 lions 'somewhere in Barbariawad'. Later a report came from the Grass Officer, Gohelwad, of a pride of 7 to 9 lions in Dedan, and finally I received a letter from the Collector, Junagadh, in which he told me that when he visited the Hill of Sana on the 29th the villagers reported that a pride of 14 lions, including lionesses and cubs, had been about the previous night, and that 6 grown lions had been seen that same morning.

(*c*) Estimate of the actual number of Gir lions.

The figures in the above table should be regarded as minimum figures. I am certain there are not less lions than they indicate.

On the other hand, as it was found that 12% of new lions (i.e. 20 in all) appeared on the second day of the census in the Saurashtra divisions, it seems reasonable to suppose that there may be up another 12% still uncounted.

In Baroda 8 new lions appeared on the second day and 4 on the third. Another 4 may not have been counted?

The Mytiala figure may be taken as exact, whilst those for the Girnar and Hill of Sana lions allow of sufficient latitude for them to remain unaltered.

On the basis of these calculations the maximum lion population will be between 243 and 251.

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[1] Since the date of the census 8 lions in all, probably belonging to this pride, have been shot at Mytiala. One of them was a man-killer. (Footnote dated 1-12-1950).

The exact number of lions is, after all, of purely academic interest. What is required are figures by which the future condition of the lions may be gauged. These the census has provided.

(*d*) Distribution.

The distribution of lions in the forest is regulated by the joint factors of the presence of water and their main supply of food . . . that is, domestic stock. This year the distribution was unusual owing to the closure of many of the forest nesses, very few lions being found in the central forest area. The majority was recorded near the forest edges and further into the Gir along certain watercourses where nesses are still occupied.

The closure of the forest nesses is probably responsible for the occasional sorties the lions have been making well into the revenue areas, for these are unusual at this time of the year.

Lions were most abundant in and around the Devalia Preserve and near Jasadhar village.

Two 8 to 10 day old cubs were found in the Mandwi centre of the Jasadhar Division.

Lions found in the Sasan Division were of small average size: those in the Jasadhar Division were large.

In all, 6 very large lions were recorded (animals with pug-marks of over 7 inches in length), 4 in the Jasadhar Division and one each in Jamwala and Baroda.

(*e*) Proportion of males to females.

Except in the Baroda and Jasadhar Divisions enumerators were not instructed to give the sex of lions whose pug-marks they found, because, in my experience, the results of such estimates are often incorrect. Nevertheless, in the light of such evidence as there is (the table given in Vol. 48 No. 3 of lions shot and found dead being the most important), and as long as there is a lack of any to the contrary, it must be assumed there is a preponderance of males. It should be noted, however, that both Dharmakumarsinhji and many experienced pagis hold the opposite view.

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3. CONCLUSIONS AND RECOMMENDATIONS

I am not prepared to hazard an opinion as to whether there are more lions now than there were in 1936, the year of the previous census. Nevertheless, that their numbers decreased between 1936 and 1947 seems more than probable. Nor can this be considered surprising when one sees the host of trophies, shot in the States where the lions were unprotected, that adorn so many of the princely homes of Kathiawar. Although lions were carefully preserved in Junagadh State (where about three were shot each year), some were also shot in the Jetpur and Baroda Gir, at Mytiala. As mentioned before, it is no exaggeration to say that as soon as any lion wandered out of the forest into the territories of the adjoining small States someone was after its skin. It was not unknown for such States to have permanent arrangements in force to account for any lion that crossed their borders, with young buffaloes tied up nightly in suitable places, permanently erected machans and machinery for the prompt reporting of a kill.

These small States accounted for perhaps 10 to 12 lions yearly, and they have been killed as far away from the Gir as in the 'cactus' jungles at Mangrol.

Now, however, both as a result of the impressions received during my two most recent visits to the Gir, and the high proportion of young lions recorded in the census, I am convinced that they are once again on the increase.

This is only to be expected if the rigid restrictions on the shooting of lions and their potentialities of rapid increase[1], are borne in mind, for between November 1947 and March of this year no permits to shoot them were granted and only a negligible number was poached. In March the situation was considered sufficiently satisfactory to allow the shooting of four male lions per year. This, it should be remarked, is the *only* measure for their control and protection that is strictly enforced at the moment[2].

The census figure of 40 young lions was based on pug measurements taken at the Junagadh Zoo. Those whose fore pug measurements were less than 4″ in length were considered to be cubs of under 6 months, and those with pug-marks of under 4½″ to be certainly no older than 18 months.

Out of these 40, 21 belonged to the first category and 19 to the second, so that, in all probability, approximately 30 of them were born within the last 12 months[3]. Unless it is assumed that the average life span of a Gir lion is a mere seven years (an assumption for which there are no grounds whatever[4]) a simple arithmetical sum will indicate that an increase in their numbers must be taking place.

This is all to the good as it shows that the general condition of the lions is healthy and that they are in no immediate danger of extinction.

However, there is as yet no room for complacency. Because they are now on the increase, there is no reason to be sure that the increase will continue. Though it is in all probability due to the rigid restrictions of the past 30 months, we cannot be certain of this. As is well known cycles of increase and decrease (phenomena whose causes are little understood) are common in nature.

As the Gir Forest is the last home of the Asiatic Lion, if only for reasons of pride in this fact, it is to be assumed that Saurashtra will do her utmost to see to the proper preservation of these animals, even, if necessary, at considerable cost to Government, and will ensure that they never again run any risk of extinction.

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[1] A Gir lioness in the Junagadh Zoo produced a litter of three cubs in August 1949 and another of five six months later. I imagine, unless the entire first litter fails to survive, two litters within the year are extremely unlikely in the wild state. Information about this would be most valuable.

[2] But refer to footnote on p. 7.

[3] Bear in mind that the death of very young cubs will not enter into these calculations, as such cubs will not normally enter into the census.

[4] According to Major S. S. Flower (*P.Z.S.*, 1931: 162) an African wild lion is in his prime of life when 5 to 6 years old. The chances of his remaining alive after 10 years depend on his individual cleverness and the absence of competitors for food.—Eds.

Any relaxation of control will undoubtedly lead to their rapid disappearance — — there is no chance now in these days of jeeps, and wholesale destruction of game, of lions lingering on in small numbers as they did during the early days of this century.

For the efficient working of any scheme of protection it seems rational to urge that the entire Gir Forest be turned into a properly constituted Lion Preserve with a responsible Warden and an adequate staff. This need not interfere with the legitimate claims of forestry because efficient management of the forest, especially afforestation and the prevention of jungle fires (the scourge of the Gir) will be of the greatest assistance in protecting the lions.

In the light of the census figures I can see no reason to suggest any modification in the quota of permits to shoot lions that are being granted at the moment. It is important, however, that another census should be held at the end of two years (and thereafter at regular two yearly intervals) and that any necessary modifications in the numbers shot be made in accordance with its results.

The shooting of specified numbers of lions can control any increase in their numbers and forestall the dangers of over-population, which may of itself bring about a reduction in numbers together with a general weakening of the stock, or cause the lions to become a menace to the countryside outside the Gir. The reopening of the closed forest nesses as soon as circumstances permit will be a precaution against the latter.

At the same time attempts should be made to reduce the losses of domestic stock within the forest[1]. It must, however, be stressed strongly that the very large majority of such losses is due to the carelessness of the *maldharis* themselves in bringing home their herds after dark, letting animals stray and failing to secure them properly at night. Furthermore, they are fatalistic about them, taking them very much as a matter of course. Perhaps they may be regarded as the bill Saurashtra has to meet for the privilege of providing a home for the lions, and as a kind of fee the *maldhari* has to pay for the admirable grazing grounds he is allowed to use at a purely nominal rent. Nevertheless, *maldharis* should be urged or compelled to pay more attention to the safety of their animals. Propaganda can do much and has performed more difficult tasks than this.

It is most important that arrangements should be made for the registering of such losses.

If the lions are to be broken from their predilection for domestic stock there must be enough wild game in the forest to supply their needs. At the moment the forest holds a fair quantity of game, though how this compares with years gone by I am not in a position to state, but if there is enough for the needs of, say, 250 lions is more than doubtful. Therefore it is reasonable to suggest that the shooting of forest game should be completely banned. An exception *may* be made of panthers (which are very abundant) as they draw largely upon the same supplies of food as the lions. Unfortunately, as the instinct to poach is so deep rooted in many otherwise respectable persons, this may defeat its own ends, as holders of permits may be found to wreak havoc among other kinds of game.

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[1] cf. Table of Losses of Cattle and Buffaloes in Vol. 48 No. 3. During my visit to Jamwala in Dec. 1949 I adopted the expedient of collecting information on losses of individual *maldharis* instead of whole villages and nesses as being more likely to be accurate. The results were about 40% less than those given in the table.

Whatever authority is in direct charge of the preservation of lions should keep careful records of those that are shot, with their measurements and other relevant details, and of lions found dead, with their sex, probable age and, whenever possible, cause of death.

* * * *

The work of the census was full of incident and has left us with a host of memories.

For myself perhaps the main recollection is of the unbelievable discomfort and dust of travelling the appalling forest tracks in an open jeep under the hot weather sun. For Dubois the most exciting moment must have been on the night of his arrival when he awoke from his sleep on Jamwala railway platform to find a panther at his side, eyeing him, so he says, with a lean and hungry look. For the Yuvraj of Wankaner, at the other end of the Gir in the Devalia Preserve, a remarkable experience was to watch a lioness pass between the tree holding his machan and the ladder leading up to it. It was, he tells me, a very low machan.

Once again I have recollections of Jasadhar, that most remote of places with its strangely attractive African landscape of acacia jungle and grass-covered hills. Strangely attractive, too, are the sonorous names of its habitations . . . Wankajambu, Tulsishyam, Vejalkotha, Chikalkuba, Nandivelo, Timberwa. It was at Jasadhar that we were compensated for the fruitless evenings we had spent waiting for panther at Christmas, when one found sleeping close to the Rawal river came out within three minutes to the bleating of a goat to be shot in the glaring light of mid-day. Nor shall we forget the dumb patience with which a bull, terribly mutilated by lions, awaited his end in the village. It was here too that the hospitable Mr. Sheikh entertained us to yet another Lucullan lunch.

The final act of the census was a visit to the Junagadh Zoo to check up on the pug measurements of young lions and cubs.

On arrival I was startled to find an infuriated young lion penned up for me in a small transportable cage fitted with a sliding partition so that its unfortunate occupant could be flattened helpless against its bars. Keepers stood by with brush, bottle of ink and several large sheets of white paper! Interesting though this experiment would have proved I felt compelled to call a halt to it and explain that it was pug-marks on the ground that I wished to measure. This, they said, was easy and led me forthwith into the cage of a lioness, where I had no difficulty in getting the data I required. Fortunately it was easy to keep her to the far side of the enclosure, but I did regard it as unnecessary for the door to be bolted after we had entered. The younger cubs presented no difficulty.

Photos Bhatt Art Studio, Junagadh

Young Gir lions on buffalo

Had we held the census three days earlier our preliminary conference at Sasan would have left us with an even more exciting memory, for the notorious dacoit Visamanjaria and three of his confederates were ambuscaded and shot dead in one of the rooms of the rest house.

The History of the Lion in Junagadh State 1880 to 1936

as derived from Junagadh State Records

(M.A W-B.)

As early as 1880 Colonel Watson considered that there were not more than a dozen lions in the Gir Forest, though there were almost certainly more than this, as the official estimate of 1893 gave a total of 31. However, that the lions were in real danger of extinction by the end of the century was indicated by another official estimate made in 1900, in which the total had dropped to 19, inclusive of 8 cubs, though, as these figures were largely based on guesswork, too much reliance should not be placed on them. There was plenty of indirect evidence that there were more lions than these figures indicated . . . especially the amount of damage done by them, and the numbers that were regularly shot outside Junagadh territory.

1899-1900 were the years of the Great Kathiawar Famine when almost all the game in the Gir Forest died from lack of water, and this had undoubtedly seriously affected the already dwindling stock of lions. Lord Curzon, who had at that time been invited to Junagadh to shoot a lion, on being informed of the situation (he was told that only about 12 lions remained) promptly cancelled his visit, and urged the Nawab (H. H. Rasulkhanji) to take steps to save the animals from extinction. The Nawab immediately agreed to do whatever was in his power, and from this dates the first attempt at their protection. Shortly afterwards, however, the Nawab wrote to the Viceroy complaining that he was receiving no co-operation from neighbouring States, and asked for his assistance. This must have been given, for both Jetpur and Baroda States promised a certain measure of help, though it will be seen that a complete ban on the shooting of lions proved impracticable.

At this time, too, probably because the Nawab was the prime mover in their protection, and because the great majority of the animals lived in his forest, arose the claim that all lions were his property, no matter in whose territory they were living. This was a somewhat unreasonable premise seeing that lions without a doubt also bred and had their being throughout the year in both the Baroda and Jetpur Gir, and one that was even less tenable as the Nawab steadily refused to admit any compensation for damage done by *his* lions in foreign territory.

And so in 1901 was recorded a complaint from the people of Mendarda, in Jetpur, about damage done there by lions, and a demand either for compensation from the Junagadh Darbar, or that Junagadh should stock their forest with goats to attract *their* beasts back to it.

No compensation was granted or considered, and no goats were sent to the forest.

In the same year it was reported that in seven months lions had killed 352 domestic animals, 2 women, one boy, and had seriously mauled a man, around the villages of Aritha, Valadar, and Harmadia in the Baroda territory to the south of the Gir. 'Lions are much bolder and enter villages during the daytime and fearlessly attack men and cattle. The police have had to exert themselves to protect human life', so reads the report. In fact they had killed one lion near Ghantwad, which seems justifiable under the circumstances, but which nevertheless brought forth a strong complaint from Junagadh. However, in reply, the Gaekwar amended his Act of 1876 which had permitted the destruction of certain kinds of game in protection of life and crops, specifically excluding lions from it, though at the same time reserving to himself the right of ordering their destruction if he thought it necessary.

The following year another lion was shot in self-defence near Ghantwad, calling forth a similar complaint from Junagadh. Lieutenant O'Brien, a political officer who had killed the lion, stated in his report that in the years 1899 and 1900 almost all the game in the forest had died off, and the lions at the time of writing were living on the edge of the Gir and preying solely on cattle with occasional human victims. He added that they had established a regular reign of terror in the Ghantwad district where a boy had been killed and eaten not long before, and that the lions had become so bold that in April they had torn the roof off a hut in a village to get at the goats inside. Two men had recently been killed as far away from the Gir as the Kodinad district. He concluded his report by stating that Junagadh must make arrangements to tie up cattle within their borders to feed the lions. In reply Junagadh suggested that the villagers should protect their cattle (and themselves) by beating drums and letting off fireworks.

In 1903 the annual trouble recurred when a lion was killed in self-defence just over the Baroda border on the banks of the Singavada River. However, at that time the situation was becoming too awkward for even the Nawab himself. In his own State in 1901, 31 men had been killed and 8 mauled by lions, and though no figures can be found for the years 1902 and 1903, it is unlikely that there was any great decrease in deaths from this cause, as 29 men were killed and 11 mauled in 1904 and the lions were once more described as becoming 'very bold'. It was, we are forced to believe, the difficulties caused in his own State rather than the complaints of his neighbours, who, on the contrary, seem to have been remarkably long-suffering, that led to the Nawab's decision in that year to 'use his discretion in shooting the lions'. And so ended the first attempt at their protection.

As the lions were maddened with hunger at that period owing to the shortage of food caused by the famine, it is probable that protection was impracticable except by the drastic step of keeping large herds of cattle and goats in the Gir exclusively for the purpose of feeding them. This obviously could not be done when man, slowly recovering from the famine years, had full need of the flocks and herds himself, and, indeed, such an action would be a matter of doubtful morality at the best of times.

For the years between 1904 and 1911, when the Nawab died and British Administration took over the state during the minority of his successor, there are no lion records to be found, though, if we are to believe Wallinger, the Chief Forest Officer in 1913, they were shot at an annual rate of 4 or 5 in Junagadh territory and 8 outside it. However, a most interesting fact to observe is that it was during these years that the habits of the lions underwent a profound change, for never again are they heard of as a menace to human life. This was in all probability the result of a return to normal conditions after the famine years. As the supply of wild game increased and especially as the herds of cattle and buffaloes in the forest grew bigger, lions would be able to pick and choose their prey, no longer being urgently driven by hunger to attack whether man was near or not. At the same time it would no longer be a matter of such vital urgency for the herdsmen to protect their beasts even at the risk of their own lives, for most of the deaths had taken place during attempts to drive off lions that were harassing cattle. Certain it is that for the last 30 or 40 years lions have been most tolerant of men and such deaths as have occurred have been caused by wounded lions or lionesses with cubs.

In 1911 British Administration took over and some sort of control over the shooting of lions was exercised, for in 1912 Ganga Singh, Maharajah of Bikaner, was refused permission to shoot one 'as they had become so scarce'.

However, in 1913, after a tour of the forest lasting for nearly two months Captain Wallinger reported that he thought that there were only from 6 to 8 lions left and that there were certainly not more than 20, the statement being supported by Mr. Brooke-Fox, the Chief Engineer of the State, a keen shikari and one who knew the forest well. The lions, it must be assumed, were at last almost extinct.

In view of the supposed condition of the lions in 1904 and the history of the previous nine years, to my mind, the interesting and important fact is that they had continued to exist at all. It says much for their powers of survival.

As a result of this report, Mr. Rendall, the then Administrator, placed a ban on the shooting of lions in Junagadh State, and at the same time urged States adjacent to the Gir to do the same.

At a later date, one assumes when the lions were thought to have increased their numbers, a limited quota (never more than three a year) was shot, and the rules for their protection that were still in force when Junagadh was taken over by the Saurashtra Government were framed.

In 1917 H. H. Ganga Singh of Bikaner was granted permission to shoot a lion, which he did, and the fact that he had *khabar* of 8 lions near Sasan points to the success of these measures and suggests that they had already rapidly increased their numbers. Ultimately, of course, they were to do so to a remarkable extent.

In 1920 P. R. Cadell, an Administrator who took a keen interest in the animals, said that their number was about 50, although 10 or 12 were poached yearly in adjacent States, such lions sometimes even being driven across the Junagadh border for this purpose or attracted there by tying up cattle.

In 1917 lions began to visit Mytiala, to the north-east of the Gir in Bhavnagar territory, where they had not been seen for many years. They have regularly visited the area since 1922 and their shooting was carefully controlled by the Bhavnagar Darbar after 1929.

In 1922 British Administration ceased and the new Nawab (H. H. Mahabatkhanji) ascended the *gadi,* to continue the good work of protection instituted by the British. Indeed his zeal in this matter promptly led him into trouble with two of India's greatest rulers, who, having failed to secure an answer from the Nawab to repeated requests to shoot a lion in the Junagadh forest arranged to hold their camp in Jetpur territory. On being approached for his co-operation in this matter, the Nawab peremptorily refused to admit they had any right to shoot *his* lions, even in another state, and *commanded* them to abandon the proposed trip. The shooting party, nevertheless, continued with their plans, but met with no success as the Junagadh *pagis* were instructed to station themselves on the border and let off guns and beat drums to scare the game. When it was realised that there was no chance of bagging a lion, the party turned their attention to panther and tied up for one that was in the neighbourhood. The Junagadh authorities, not to be outdone, immediately crossed the border, managed to kill the panther, cut off its head and legs, and insultingly left the carcass to rot. After this it is hardly surprising that relations between the Nawab and the two rulers were strained, but a more friendly atmosphere was eventually restored by the presentation of a magnificent rifle to the Nawab as a peace-offering.

The following year it was again recorded that 12 lions had been shot outside Junagadh territory.

From this date until 1936 records are again absent, but it must have been a period of steady increase in the numbers of lions (in spite of continued 'poaching' in neighbouring states), as the census of 1936 gave a total of 287 lions in Junagadh territory.

NOTES ON SOME ASIATIC STURNIDÆ (BIRDS)[1]

BY

DANIEL MARIEN

(*With a text map*)

(Communicated by Dr. Ernst Mayr, New York)

INTRODUCTION

Indian starlings include the genera *Saroglossa* (1 species), *Sturnus* (10 species), and *Gracula* (2 species). Except for *Saroglossa*, of Madagascan affinity, and the specialized *Gracula*, these are the more 'typical' members of the family in the sense of being the ones most familiar in other countries where they have been introduced.

The status of the genera has already been reviewed by Amadon (1943 b); in this paper it has been possible to reassess the status of some of the lesser taxonomic groups of the Indian sub-region. Some suggestions are made for further investigation in the field, two forms recognized in the New Fauna are found not to be valid, a recently described race confirmed, and a hitherto unnoticed plumage in *Saroglossa spiloptera* studied.

Dr. Walter Koelz's industrious collecting in India, Persia, and Afghanistan has supplied workers at the American Museum of Natural History in New York with an unparalleled opportunity for a systematic study of the Indian fauna and this review is chiefly based on his specimens. His superb material, in most cases with all plumages adequately represented, gives us a more up-to-date and accurate picture of the avifauna, and concomitantly new biological and distributional problems suggest themselves.

The systematic arrangement follows that of Amadon (1943 b) in his review of the genera of starlings. I am in agreement with his decision to unite *Pastor*, *Sturnia*, *Sturnornis*, *Sturnopastor*, and *Temenuchus* with *Sturnus*. His suggestion that *Acridotheres* will be considered by some authorities as not deserving generic distinction is justified. The one constant character by which *Acridotheres* differs from *Sturnus*, a tendency for the possession of a frontal crest, is too trivial in comparison with the many features which they share to warrant excluding *Acridotheres* from the enlarged genus *Sturnus*.

Measurements: All measurements are given in millimeters and are of adult birds in the Koelz collection. Wing length was measured with the wing pressed flat against the rule. The bill was measured from the anterior edge of the nostril.

Localities: The localities of the specimens in the Koelz collection are given with the expectation that they will prove useful in extending the knowledge of the distributions of Indian birds.

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[1] Notes from the Walter Koelz Collections, Number 9.

Saroglossa spiloptera (Vigors)

Synonym: *Saroglossa spiloptera assamensis* Baker (Type locality: Khasia Hills).

UTTAR PRADESH (United Provinces): Kathgodam, April 6–10, 1948, 4 ad. ♂, 3 ad. ♀. Kumaon: Bageswar, June 2, 1 ad. ♂. 3 ad. ♀. NEPAL: Amlekhganj, March 8–9, 1947, 3 ad. ♂, 2? imm. ♂, 2 ad. ♀; Hitaura, June 12, 17, 21, 2 ad. ♂, 1 ad. ♀, July 19, 1 imm. ♂.

Stuart Baker (1924) proposed the name *assamensis* for an eastern race of this species which he characterized as ' deeper and more richly colored above and below in both sexes. In the male the grey centres to the feathers of the back are bolder and the margins less brown.' Ticehurst (Stanford and Ticehurst 1935) was correct in not recognizing this race; he noted that the male plumage is variable and that western Himalayan birds are similar to those from Assam.

Also, without apparent foundation, Baker (1926, 1933) extends the eastern border of the species's range to include Burma, Shan States, Yunnan, Annam, Cochin China and southwestern China. This is decidedly incorrect. In Burma it is only a winter visitant (Stanford and Ticehurst, 1938) as it must also be in Siam. Rothschild (1926) in his complete survey of the Yunnan avifauna does not even mention this species; still later Stanford and Ticehurst (1938) could say it " has not been recorded from Yunnan." Mr. Jean Delacour tells me that it has never been found in Indo-China, nor am I able to trace any record of its occurrence there.

It must be considered as breeding in the Himalayas from eastern Assam (and possibly adjacent areas in northwest Burma) westward at least to the Kangra Valley in Punjab.

Although I have seen no molting specimens, it is probable that there is a single, post-nuptial molt which occurs between July and November; freshly molted birds are to be found in November while the specimens collected between February and June are worn.

Many females have a few chestnut feathers dispersed among the brown throat plumage, a condition I have not seen previously described.

In this species there appear to exist two types of first year male plumage. It has previously been assumed that the young resemble the female, but that the markings of the juvenal are more streaked. Among the examples of this starling collected by Koelz are three specimens which strongly suggest that the plumages of this species are not as simple as commonly believed.

One type of first year male plumage is exhibited by a fledgling male, with gape still fleshy, collected at Hitaura, Nepal, July 19, 1947. The plumage of this individual approaches that of the adult male in several respects and so definitely differs from what has been regarded as the normal immature plumage that it deserves a detailed description.

Breast, abdomen, flanks, and under tail coverts pale rufous, except for dull white area in center of abdomen; feathers of the throat dull white, but the shafts, and edges brown, imparting a streaked appearance; primaries dull black, glossed with green; secondaries browner, and the outer vanes already elongate, producing the characteristic grey patch; upperparts brown, becoming rufous on the scapulars tertials, rump, and upper tail coverts; the entire back has a more rufous aspect than that of the female; tail dusky brown above, below, the rectrices are grey-brown on the outer vanes and pale rufous on the inner vanes; axillaries pale rufous; under wing coverts at bend of wing brown, barred with rufous; thigh rufous; feet black although the colors of the soft parts were not recorded on the label.

It will be seen at once that it resembles the adult male in the rufous and unstreaked underparts and the glossy black wings, characters never present in the female.

The second type of plumage is undoubtedly the one Baker (1926) and others considered as that of the immature male. At Amlekhganj, Nepal, March 8–9, 1947, Koelz collected two males (although one was doubtfully sexed as such) displaying that plumage. Measurements[1] indicate they are males. Both birds are virtually identical with all the females I have examined but are larger and with a slightly more extensive white area on the abdomen. One would expect, however, that a male taken in the spring would possess the fully adult male plumage. The nesting season, as given by Baker (1933), is from April to June. It is therefore probable that these birds have passed the winter in this female-like plumage.

Similar cases of a divergence of plumages in the same sex have been discussed by Mayr (1933), particularly in *Neolalage banksiana*, and by Amadon (1943a) in *Gallicolumba stairi* and some races of *G. beccarii*. In *G. stairi* it was found that females possessed, besides the feminine type adult plumage, a male type adult plumage almost identical with that of the male. Amadon regarded the male type plumage as advanced ("progressive") and the female type as retarded; the normal juvenal plumage in that species resembles the female plumage.

In *Neolalage banksiana*, Mayr found two immature plumages, one which was described as normal and the other as "progressive" which approaches in coloration the adult plumage. Birds possessing either plumage eventually molt into the adult dress.

Both cases are somewhat analogous to the condition in *S. spiloptera* but it is not yet possible to say which case more nearly resembles that of the starling. It is not clear from the material so far available whether the feminine type male plumage persists in the adult male, or whether after the next molt the fully adult male dress is acquired by those males with a feminine type plumage.

It is not known, of course, if earlier collectors, upon taking a male in the feminine type plumage automatically labelled them immatures because of the condition of the plumage. New specimens of this bird should be carefully sexed and the breeding condition ascertained so that it may be possible to decide if the males in female plumage are first year birds in progressive plumage or adult birds in retarded plumage.

MEASUREMENTS: Wing: ♂♂, 110, 110, 110, 110, 111, 111, 111, 115; ♀♀, 105, 105.5, 106, 106; Tail: ♂♂, 56, 57, 57.5, 57.5, 58.5, 59, 60.5, 61, ♀♀, 54, 55, 56, 56, 57.5. Bill: ♂♂, 13.5, 13.5, 13.5, 14, 14, 14.5, 14.5, 15, 15, 15; ♀♀, 13, 13, 13.5, 14, 14, 14, 14, 14, 14.

Superspecies **Sturnus malabaricus**

As currently treated, there are six named races of the Grey-headed Myna: of these, three races are endemic on islands in the Bay of Bengal and three races occur on the mainland of southeastern Asia from southern India to Indo-China. Ticehurst (1940) has suggested the possible inclusion of *Sturnus senex* of Ceylon as a subspecies of *S. malabaricus*, but all authors, although cognizant of the relationship of the two forms, have retained *senex* as a full species.

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[1] (in mm.) Wing: 109, 111; tail. : 59, 60; bill : 13.5, 15.5.

Ripley (1949) characterizes *S. senex* and *S. malabaricus* as members of a superspecies. The distribution of *senex* and the continental races of *malabaricus* suggests to him that the latter may have invaded peninsular India during periods of low temperature and high humidity; the route postulated is across the main watershed of India: the Khasia Hills-Kaimur Ridge-Vindhya Hills mountain chain from Malaysia. The populations on Ceylon and along the Malabar Coast became isolated during succeeding periods of high temperature and decreased humidity and evolved during these periods of isolation into the subspecies *blythii* and the strikingly different *senex*.

This does not seem completely convincing. *S. senex* appears to be a more primitive species; it is crestless, the underparts are streaked like the juvenals of some species of *Sturnus*, and the crown, back and rump are dull colored, not glossy. It is so different from *malabaricus* that it becomes difficult to conceive of *blythii* and *senex* being evolved from the same immediate ancestral stock. Ceylonese forms are rarely so different from their mainland congeners. It appears more likely that *senex* is a relict of species which was once more widespread in India, having become extirpated over most of its range but managing to survive on Ceylon.

There are two morphologically distinct groups within *malabaricus*. As a unit the three island races are as different from the mainland races as the Ceylonese species is from either group; at the same time the races of each group have such an extremely similar color pattern as to emphasize the dichotomy. It seems necessary to raise each group to species rank and to exclude the primitive *senex* as a member of the superspecies. The superspecies *S. malabaricus* would then include the two polytypic species *S. malabaricus* and *S. erythropygia*, each with three subspecies.

Because of their similar appearance and local migrations some confusion has been evident in previous statements of the breeding ranges of the races of *malabaricus*. I have attempted below to give the probable distributions.

S. m. malabaricus and *S. m. blythii*. Compared with the ranges of the two other races of *malabaricus* the range of the southern Indian race, *blythii*, is a rather limited one. Reliable breeding records for this subspecies have been established for northern Kanara, Coorg, and 'the parts of Mysore bordering on the Wynaad.' (Whistler and Kinnear, 1933). Sálim Ali and Whistler (1936) state that *blythii* is the breeding form of Travancore, the nominate race appears in that locality only as a winter visitant. Sálim Ali (1943) says that *blythii* is resident in Mysore, but his are all winter specimens and he gives no breeding data. Whistler and Kinnear (1933) are emphatic in denying that either race breeds in Belgaum. Koelz's series, from just south of Belgaum, offers no breeding records but shows that both subspecies may occur together there in winter.

Before proceeding further it will be useful to summarize what has so far been established. The race *blythii*, then, is restricted as a breeding bird to the southern Indian hills from Travancore to north Kanara and eastward in the hills of Mysore. It appears to be separated by a considerable gap from nominate *malabaricus*; the latter is known to breed from Mewar and Madhya Pradesh (Central Provinces) eastward to Assam and Bengal and north in the Himalayan foothills from Dehra Dun to Mishmi Hills.

The wintering records of *blythii* are unusually interesting, for on the basis of the known range they give evidence of a northward migration after breeding, an otherwise unprecedented movement among Indian starlings. Specifically, *blythii* has been found in winter, together with *malabaricus*, in Travancore and Mysore, just south of Belgaum, and as far north as Bombay City (Sálim Ali and Abdulali 1937)[1]. There are two possible interpretations : the first that *blythii* wanders north after nesting and the second that the movement is only an apparent one, the visitants coming from unkown breeding areas further east and not from the south.

Additional light is shed upon this question by some of the Koelz specimens. Of fourteen specimens from Londa and Jagalbed, seven are *blythii*, five are nominate *malabaricus*, and three appear intermediate. These three birds have the crown and nape white, like *blythii*, but the white of the throat does not extend onto the breast. (The extension caudad of the white of the throat, in some cases reaching the abdomen, will always separate typical *blythii* of both sexes from *malabaricus*). It is evident that the two races are interbreeding in an as yet undetermined area.

It is therefore possible that the ranges of *blythii* and the nominate race are more extensive than previously believed. The evidence points to a more northerly and easterly distribution for *blythii* than has been yet reported. The nominate race should be found breeding further southwest into Gujarat, hybridizing with *blythii* in that general region. The white-headed subspecies seem to be only slightly or locally migratory, whereas the nominate subspecies is distinctly migratory.

S.M. MALABARICUS and *S.M. NEMORICOLA*: The third mainland subspecies, *nemoricola*, is found from northern Burma and northwestern Yunnan to southern Annam, Siam and Tenasserim. The breast and abdomen are normally greyish-white, but in this exceedingly variable form some specimens are almost indistinguishable from *malabaricus* in the amount of ferrugineous on the underparts. The alula and primary coverts are frequently white, but this character is not constant; individuals may be found which have some or all of the coverts, and the alula, black. I have examined a specimen of *malabaricus* from Nepal which has the left alula white and the right one black. This is unusual, for that race otherwise has those feathers black.

Two specimens from Pantha, Upper Chindwin, identified as *malabaricus* (Mayr, 1938) are really *nemoricola*. The male is quite erythritic below, but the female is greyish-white, the usual condition in this race. This subspecies also occurs in the Myitkyina District of northern Burma, (Stanford & Ticehurst, 1938).

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[1] We have since seen specimens collected at Ahmedabad in Gujarat, ca. 300 miles north of Bombay city.—EDS.

In the use of the appended key to the subspecies, it must be remembered that because of the variability of this species specimens may be encountered which will not fit the key. Intermediates will also be a source of difficulty. Such cases are best treated by assigning the bird in question to the proper race on the basis of range. Here again difficulties will be met with for in winter two forms may occur in the same locality, especially along the Malabar Coast in southern India and the Arakan Coast of Burma.

Useful accounts of the intraspecific variation that is known to exist in *S. malabaricus* are to be found in papers by Deignan (1945) and Stanford & Ticehurst (1938).

KEY TO THE SPECIES AND SUBSPECIES OF THE *Sturnus malabaricus* GROUP (adults only)

1.	Secondaries, tertials, and central tail feathers black, glossed with green; never grey	(species *erythropygia*)	2
	Secondaries, tertials, and central tail feathers grey	(species *malabaricus*)	4
2.	Rump and upper-tail coverts pearly grey or roseate, never deeply ferrugineous ...		3
	Rump and upper-tail coverts chestnut (Car Nicobar only) ...	*erythropygia*	
3.	Under-tail coverts pinkish buff or white (Andaman Islands only) ...	*andamanensis*	
	Under-tail coverts rufous (Katchal Island only)[1] ...	*katchalensis*	
4.	Crown and nape white or pale grey, never conspicuously streaked; breast always white; rump grey (southwest India) ...	*blythii* (males)	
	Crown and nape grey, sometimes streaked with black and white; if crown white or unstreaked grey, then rump buffy ...		5
5.	Breast sullied white or grey, sometimes tinged with rufous; rufous usually restricted to lower flanks and abdomen ...		6
	Breast and abdomen rufous ...		7
6.	Rump grey, sometimes tinged with ochraceous (southwest India) ...	*blythii* (females)	
	Rump distinctly buffy (Burma, Siam, Yunnan, Annam) ...	*nemoricola* (part)	
7.	Rump distinctly buffy, head sometimes almost white (Burma, Siam, Yunnan, Annam) ...	*nemoricola* (part)	

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[1] Specimens not seen; adapted from Stuart Baker (1926).

Rump grey, sometimes faintly tinged with rufous (Himalayan foothills from Dehra Dun to Nepal, Assam and Bengal; in winter to South India and Arakan Coast of Burma) ... *malabaricus*

STURNUS MALABARICUS BLYTHII (Jerdon)

(Including intermediates)

SOUTHERN BOMBAY PROVINCE: Londa, Jan. 16, 1938, 1 ad. ♂, Jan. 19, 1 ad. ♂, Jan. 26–29, 3 ad. ♂, Feb. 6, 1 ad. ♂, Feb. 12, 1 ad. ♂.

(The following birds are all intermediate between this race and nominate *malabaricus*): Londa, Jan. 30, 1938, 1 ad. ♀, Jagalbed, Feb. 19, 1 ad. ♂, March 10, 1 ad. ♂.

In the Indian starlings as a group, except for small size differences, there is almost no sexual dimorphism. It is therefore curious that in *S. malabaricus* there should be a distinct trend toward such differentiation. In both this and the nominate race the females differ from the males in having the rufous underparts very much paler. The females of both of these races are rather similar, but in *blythii* the male only has evolved a white, unstreaked crown. The sexes of *nemoricola* are only distinguishable by average size differences. The mainland races of this species thus show an increasing differentiation of the sexes from the easternmost to the westernmost subspecies.

MEASUREMENTS: (Adult males only) wing: 96, 99, 102·5, 104, 104·5, 105, 107; Tail: 62, 63, 65, 65, 66, 67, 67·5; Bill: 14·5, 14·5, 14·5, 15, 15, 15, 16.

STURNUS MALABARICUS MALABARICUS (Gmelin)

SOUTHERN BOMBAY PROVINCE: Londa, January 16, 1938, 1 ad. ♂, Jan. 27 1 ad. ♀, March 12, 1 ad. ♀; Jagalbad, March 3, 1 ad. ♂.

KATHIAWAR: Junagadh, Sasan, Feb. 1, 1949, 1 ad. ♂.

NEPAL: Simra, March 5, 1947, 2 ad. ♂; Amlekhganj, March 6–7, 1 ad. ♂, 1 ad. ♀; Thankot, April 12, 1 ad. ♀; Hitaura, May 16-June 16, 7 ad. ♂, 3 ad. ♀, 1 imm. ♂.

UTTAR PRADESH (United Provinces): Kumaon, Kathgodam, April 6, 1948, 1 ad. ♂, Aug. 18, 1 ad. ♀; Bageswar, April 22, 1 ad. ♀; Gorakhpur, Jan. 26–27, 1947, 1 ad. ♂, 2 ad. ♀.

MADHYA PRADESH (Central Provinces): Bichhia, July 9–22, 1946, 1 ad. ♂, 2 ad. ♀, 1 unsexed ad., 1 imm. ♂; Belwani-Kisli, July 30, 1 imm. ♂, 1 imm. ♀; Mandla, Oct. 14, 1 ad. ♀. Amraoti, Bastar, March 27, 1949, 2 ad. ♂.

ASSAM: Khasia Hills, Umran, April 9–12, 1949, 1 ad. ♂, 3 ad. ♀; Nongpoh, April 20–25, 1 ad. ♂, 2 ad. ♀.

The post-nuptial molt begins very early in July; I have found no molting birds after September, but the material examined was scanty. It seems probable that individuals molt rapidly.

MEASUREMENTS: Wing: 9♂♂, 98–106 (102·3); 6♀♀, 96–102 (98·3). Tail: 6♂♂, 59–65 (62·8), 8♀♀, 60–63·5 (61·6). Bill: 18♂♂, 11·5–15 (13·0), 19♀♀, 12–14 (13·3).

Sturnus pagodarum

Most authors have been agreed that there are no subspecies of the Brahminy Myna and that the species is uniform across its entire range in India from Assam to Afghanistan and south to Ceylon. It seems to have been overlooked that the resident birds of the plains of south

India exhibit a constant color difference when compared with other Indian birds. They are distinctly browner-backed whereas the northern and southern hill populations are gray-backed. They are also very slightly smaller, but not sufficiently so as to be separable on the basis of that character alone. It is probable that a large enough series would demonstrate the existence of a regular clinal increase of size from south to north ; this is suggested by the material at hand but the trend is not clear.

Koelz (1939) noted that his specimens from northern India and Afghanistan were grayer than his specimens from Madras, but thought that in addition the Afghanistan birds could be separated from those of Bombay, Lucknow and Nepal ; for the latter he suggested the name *sylvestris* of Hodgson (1836). Accordingly, he named the former *afghanorum*, at the same time indicating that he considered it probable that Punjab and Rajputana birds would also belong to that race.

I have examined the type series from which *afghanorum* was described and although they are on the whole slightly paler than Indian specimens they are decidely more worn than the latter. Since there are indications that birds in fresh plumage are darker, it is not possible to be certain that the differences seen are not caused by wear. I believe that at the present time it is best not to recognize a distinct Afghanistan race, although one could, with some justification, expect that the population of the dry northwest will prove separable when more specimens are forthcoming.

Adults have been found molting as early as August 28 and as late as December 26. Two birds were found molting exceptionally late : a male taken January 3 at Mandasa, Madras Province, molt almost completed, and a female collected on February 6 at Sasan, Junagadh, just beginning to molt. There are two to three broods per year in this species and late-molting birds might conceivably be ones which have attempted to raise the maximum number of young. There is no substantial evidence for a pre-nuptial molt.

STURNUS PAGODARUM PAGODARUM (Gmelin)

Madras Province : Saba, Jan. 27, 1937, 1 ad. ♂ ; Mandasa, Jan. 30, 1 ad ♂ ; Nilambur, March 3–5, 1 ad. ♂, 1 ad. ♀ ; Salem, March 11–12, 1948, 1 ad. ♂, 1 ad. ♀ ; Cudapah, March 19, 1937, 1 ad. ♀ ; Sidhout, March 21–22, 3 ad. ♂, 4 ad. ♀ ; Hospet, March 25, 1 ad. ♂.

The type locality of *Turdus pagodarum* Gmelin is Malabar and Cormandel (Gmelin, 1789) and therefore this name must be restricted to the population of the plains of southern India. *Sturnus subroseus* of Shaw and Nodder (1808) is based on a description by Levaillant (1799) of 'le Martin Brâme'. Levaillant's description : 'Le manteau, les scapulaires, les recouvrements du dessus de l'aîle, les moyennes pennes de l'aîle, le dos, les couvertures du dessus de la queue et les deux plumes du milieu de la queue, sont d'un gris roussâtre,' and the illustration (plate 95) indicate that a brown-backed bird is the form described. Clearly then, *Sturnus subroseus* Shaw and Nodder is a synonym of *pagodarum*, and to underscore this I restrict the type locality of *S. subroseus* to Malabar District, Madras Province.

Measurements : Wing : ♂♂, 103, 104, 105, 107, 108, 110, 110, 110; ♀♀, 99, 99, 99, 100, 100, 101, 101. Tail: ♂♂, 64, 64, 66, 66·5, 67, 67, 67·5, 71·5 ; ♀♀, 60, 60·5, 61.5, 64, 64, 64. Bill : ♂♂, 10, 12, 12, 12·5, 13·5, 14, 14, 14; ♀♀, 11, 11·5, 12, 12, 12, 12, 13.

STURNUS PAGODARUM AFGHANORUM (Koelz)

AFGHANISTAN : Marmakhel, May 20–24, 1937, 3 ad. ♂, 1 ad. ♀; Chandau, June 7, 2 ad. ♂, 1 ad. ♀; Tagau, June 8, 1 ad. ♂ (type).

INDIA : PUNJAB : Kulu Valley, Kulu, June 3–4, 1933, 1 ad. ♂, 1 ad. ♀; Dartse Valley, Lahul, Oct. 10, 1936, 1 imm. ♂, 1 imm. ♀.

SOUTHERN BOMBAY PROVINCE : Londa, Jan. 12—March 12, 1938, 4 ad. ♂, 3 ad. ♀; Jagalbed, June 9, 1 ad. ♀.

KATHIAWAR : Sihor, Jan. 26–28, 1949, 2 ad. ♂; Junagadh, Sasan, Feb. 6, 2 ad. ♀.

RAJPUTANA : Mewar, Udaipur, April 22, 1937, 2 ad. ♂; Sirohi, Anadra, Dec. 29, 1948, 1 ad. ♂.

MADHYA PRADESH (Central Provinces): Bheraghat, March 3—April 12, 1946, 6 ad. ♂, 1 ad. ♀, Nov. 13, 1 ad. ♂, Dec. 12–24, 2 ad. ♀, 1 imm. ♀; Bichhia, July 22, 2 imm. ♂. Ramanujgang, Surguja : Oct. 6–9, 1947, 1 ad. ♂, 1 ad. ♀.

BIHAR : Mohammadganj, Aug. 23–30, 1947, 2 ad. ♂, 1 imm. ♂, 2 imm. ♀; Garhwa Road, Sept. 12, 1 ad. ♂; Nawadah, Nov. 12, 1 imm. ♀.

UTTAR PRADESH (United Provinces) : Benares, Jan. 22, 1947, 1 ad. ♂; Lucknow, Dec. 10–11, 1936, 3 ad. ♂, 1 ad. ♀.

When Koelz (1939) gave a diagnosis of this race and applied Hodgson's (1836, p. 771) name *sylvestris* (*nomen nudum*) he therefore became the author of *sylvestris*. However, *sylvestris* is best considered a synonym of *afghanorum* and will be available if Afghanistan and Indian birds should prove distinct.

MEASUREMENTS : Wing : 26 ♂♂, 104–115 (109·2); 9 ♀♀, 97, 103·5 (101·2). Tail : 18♂♂, 66–73 (69·5); 9♀♀, 56–68·5 (64·1). Bill : 30 ♂♂, 11·5–15 (13·0); 10♀♀, 11–14 (12·6).

Sturnus roseus (Linnaeus)

IRAN : Luristan, Durud, April 21–22, 1941, 2 ad. ♂; Khorasan, Bujnurd, Aug. 2, 1940, 1 imm. ♂; Robat i Khan, Sept. 2–3, 1 imm. ♂, 1 imm. ♀.

AFGHANISTAN : Khaksan, July 9, 1937, 2 ad. ♀; Faizabad, July 10–12, 2 ad. ♂, 1 ad. ♀; Khaisabad, July 15, 1 ad. ♂, 2 ad. ♀, 1 sub-ad. ♀, 2 fledgling ♀; Zebak, July 21, 1 imm. ♀; Iskarzir, July 30, 1 ad. ♀; Jurm, Aug. 8, 1 imm. ♀; Tuti, Aug. 15, 1 imm. ♂; Sabz Pass, Aug. 29, 1939, 2 imm. ♂; Balkh, Sept. 20, 1937, 1 imm. ♂; Zehnadir, Sept. 26, 1939, 1 ad. ♂.

INDIA : SOUTHERN BOMBAY PROVINCE : Londa, Jan. 15–28, 1938, 3 ad. ♂, 1 ad. ♀, 1 unsexed ad.

KATHIAWAR : Junagadh, Jamwala, Feb. 10, 1949, 1 ad. ♂.

MADHYA PRADESH (Central Provinces) : Mandla, Oct. 14, 1946, 1 imm. ♀; Bheraghat, Dec. 26, 1 ad. ♂, March 13–22, 1 ad. ♂, 2 ad. ♀, 1 subad. ♀.

The Rosy Pastor is a breeding bird of the Palaearctic and a migrant and winter visitor to India. The movements and status of this species have been summarized, for the Indian area, in a recent paper by Abdulali (1947). From the breeding grounds in southeastern Europe and Russian Turkestan flocks appear as early as July and enter India from the northwest between Baluchistan and the foot of the Himalayas. This starling may be found throughout the winter in peninsular India and Ceylon ; the return flight begins in March and is generally over in April.

In Afghanistan, it is considered a passage migrant on the route to and from India. Whistler (1945, pp. 112–114) has very little information about its movements in autumn,[1] recording only one bird taken

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[1] Spring passage through Northern Afghanistan has been described by Meinertzhagen (*Ibis*, 1938 : 499–500)—EDS.

July 6 at Tala. The Koelz specimens indicate that this migration starts early in July and maintains at least as late as September 26.

Although it had been suggested at one time or another that the Pastor might be found breeding in Afghanistan, Whistler (*loc. cit.*) concluded that there was no evidence for it. This bird must now be considered as having bred at least once in Afghanistan, for Koelz collected two fledgling females on July 15, 1937, at Khaisabad, with the nestling down still clinging to the tips of the juvenal feathers and the new rectrices and remiges still in their sheaths. These are unquestionably the young of birds that had nested locally.

There is a single, post-nuptial molt. Two years seem to be required to attain the fully adult plumage. The immature molts from a light brown, streaked plumage into a plumage similar to the pattern of the adult female, but duller and browner. Individuals in this first winter plumage I have referred to as 'sub-adult' but do not imply that such birds do not breed until gaining the nuptial feathering. Whether such sub-adults breed is not stated in the literature.

Sturnus contra contra (Linnaeus)

Synonym : *Sturnus contra dehrae* (Baker).

Uttar Pradesh (United Provinces) : Benares, Jan. 23, 1947, 1 ad. ♂, 1 ad. ♀; Gorakhpur, Jan. 28, 1 ad. ♂; Nichlaul, Feb. 5, 1 ad. ♀; Lechiwala, Sept. 9, 1948, 1 ad. ♂, 1 ad. ♀; Lucknow, Dec. 10–12, 1936, 1 ad. ♂, 1 ad.♀.

Madhya Pradesh (Central Provinces) : 7 miles north of Jubbulpore, Feb. 24, 1946, 1 ad. ♀; Raipur, March 31–April 1, 1949, 2 ad. ♂, 2 ad. ♀; Mandla, June 21, 1946, 1 ad. ♂, Oct. 17, 1 ad. ♀, 1 imm. ♂; Bichhia, Oct. 7, 1 imm. ♂, 1 imm. ♀; Bheraghat, Dec. 6–29, 5 ad. ♂, 1 unsexed ad, Jan. 17, 1947, 1 ad. ♀. Surguja : Ramanujganj, Sept. 6–8, 1947, 2 ad. ♀, 1 imm. ♂, 1 imm. ♀.

Bihar : Mohammadganj, Aug. 25, 1947, 1 ad. ♂.

Bengal : Dacca, Jan. 14–17, 1937, 1 ad. ♂, 1 ad. ♀; Sukna, Dec. 27, 1936, 2 ad. ♂; Siliguri, Dec. 30, 1 ad. ♂, 1 ad. ♀.

Assam : Khasia Hills, Barni Hat, May 15, 1949, 1 ad. ♂.

The type of *dehrae* (Baker, 1925, p. 103), taken in 1870, is from the Hume Collection, and one cannot but suspect that this specimen, and perhaps also the remainder of the type series, had faded over the years. It is known that the Hume Collection remained in India many years before being finally brought to the British Museum, and modern facilities for properly caring for a collection were not available to Hume. It is therefore not surprising that more recent specimens, when compared with this material, should appear to be different.

I have examined a series from near the type locality of *dehrae* and do not find them to be paler than birds from Bengal and Northern Cachar. Accordingly, I do not consider *dehrae* worthy of subspecific recognition.

The type locality of *contra* was restricted to Calcutta by Baker (1927, p. 62). This would seem an unfortunate choice if *dehrae* were really valid, for Baker's own description of the ranges of the two races would place the type locality almost in the zone where the two forms would meet.

Range : Plains of northern India from the United Provinces and Central Provinces eastward to Assam. It is replaced in northern Burma by *S. c. superciliaris*.

Molting individuals are to be found from Aug. 25 to the end of December. The bill of young birds is horn color and the legs darker than those of the adult. The bright yellow bill, so characteristic of the adult, is probably acquired in January or February.

Measurements: Wing: ♂♂, 120, 120.5, 121, 122, 122, 122, 123, 125, 125, 126, 126; ♀♀, 114, 117, 118, 118, 120, 120, 120, 120, 120, 120. Tail: ♂♂, 68, 69, 69, 69, 70, 70, 70, 71, 72, 74, 74, 74, 75; ♀♀, 64, 64, 65·5, 65·5, 67, 67·5, 68, 68, 68·5, 70, 72. Bill: 17 ♂♂, 19–21 (20·0), 12 ♀♀, 18–21·5 (19·4).

A new subspecies, *sordidus*, (type locality: Sadiya, north-eastern Assam), has recently been described by Ripley (1950). It is separated from the nominate race as "having the streaklets on the shoulders much reduced, and ... lacking on the nape." The streaklets are "sepia rather than vinaceous or drab." In addition, the new race is said to be darker on the underparts than *contra*. The range is given as "Northern Assam from Dibrugarh and Margherita north to the foothills around the Brahmaputra gorges and east through the Lohit Valley."

In the Rothschild Collection there is only one specimen from the range of this proposed race. It comes from Margherita and does not differ from nominate *contra*; it shows none of the stated characters of *sordidus*.

Sturnus tristis tristis (Linnaeus)

Afghanistan: Marmakhel, May 23, 1937, 1 ad. ♀; Laghman, May 25, 1 fledgling ♀, May 26, 1 ad. ♀; Tashkurgan, Sept. 4, 1 ad. ♀. Akcha, Sept. 8, 1 ad. ♀; Sept. 17, 1 ad. ♂, 1 ad. ♀, 1 imm. ♂; Shirburgan, Sept. 13, 1 ad. ♂; Bai, Sept. 18, 1939, 1 ad. ♂; Kandahar, Oct. 21–24, 1937, 3 ad. ♂, 3 ad. ♀; Andkhui, Nov. 20–24, 1 ad. ♂, 2 ad. ♀; Balkh, Nov. 27, 1 ad. ♀.

Kashmir: Bandipur, July 30, 1936, 1 imm. ♂, 1 imm. ♀.

Punjab: Kulu Valley, Kakinal, June 4, 1936, 1 ad. ♂.

Sind: Khinjar Lake, Feb. 16, 1934, 1 ad. ♂.

Kathiawar: Junagadh, Jamwala, Feb. 10, 1949, 1 ad. ♀.

Southern Bombay Province: Londa, Jan. 15–27, Feb. 6–14, 1938, 3 ad. ♂, 5 ad. ♀; Jagalbed, Feb. 19–27, 2 ad. ♂, 1 ad. ♀; Supa, Feb. 27, 1 ad. ♂.

Madhya Bharat (Central Provinces): Saugor, Feb. 21, 1946, 1 ad. ♂; Bheraghat, March 26–27, 2 ad. ♂, Dec. 1, 1 imm. ♂; Bichhia, July 15, 1 imm. ♀; Kanha, Sept. 1, 1 imm. ♀. Surguja: Ramanujganj, Oct. 5, 1947, 1 ad. ♂; Khuri, Oct. 28–29, 6 ad. ♂.

Bihar: Mohammadganj, Aug. 24, 1947, 1 ad. ♂, Sept. 5, 1 ad. ♀; Garhwa Road, Sept. 21, 1 ad. ♀.

Uttar Pradesh (United Provinces): Gorakhpur, Jan. 28, 1947, 1 ad. ♀; Nichlaul, Feb. 12, 1 ad. ♂; Kathgodam, Aug. 20, 1948, 1 ad. ♂; Lucknow, Dec. 13, 1936, 1 ad. ♀.

Nepal: Simra, March 4, 1947, 1 ad. ♂; Amlekhganj, March 10, 1 ad. ♀; Thankot, March 23, 1 ad. ♀; Chitlang, April 16–22, 3 ad. ♂, 1 ad. ♀; Hitaura, May 15, 1 ad. ♀, May 30, 1 ad. ♂, June 16, 1 imm. ♂, 1 imm. ♀, July 14, 1 ad. ♀, July 20, 1 ad. ♀.

Bengal: Dacca, Jan. 17, 1937, 1 ad. ♂.

Within the past quarter of a century the range of this myna has undergone a vigorous expansion until it has now appeared as far east as Indo-China and as far west as Afghanistan and Turkestan. In addition it has been introduced by man in many areas remote from its original range. Perhaps because of the large population size and ability to colonize across what would prove effective barriers for other species it has not evolved into more than two distinct races.

It has been customary to separate the darker Ceylon bird as the subspecies *melanosternus*. Numerous authors have remarked on the intermediate population resident in Travancore; these birds are lighter than those from Ceylon but darker than northern Indian birds. As yet, no one has attempted to name this population although Baker (1926) suggested that such a course might be possible. Even though the differences may not be sufficient to express in taxonomic terms it may be desirable to recognize the situation as a clinal increase in depth of color from northern to southern India.

Although the period of molt extends at least from the end of July through November, individual birds appear to molt quite rapidly. In several specimens the entire head, including crown and throat, appears naked, except for the tiny incoming feathers which are all at the same stage of development. The tail molt is also rapid ; after the central pair have been renewed all the others are replaced almost simultaneously.

With wear, the plumage of the back becomes more red-brown.

Measurements : Wing : 13♂♂, 146–153 (149·3) ; 16♀♀, 137–147·5 (141·9). Tail : 8♂♂, 88–93·5 (90·9); 11♀♀, 80–89 (85·0). Bill : 32♂♂, 14–18 (16·2); 29♀♀, 14–18 (15·18).

Sturnus ginginianus (Latham)

Punjab : Patiala, Gagga, Jan. 22, 1948, 1 ad. ♂.

Rajputana : Sirohi, Sirohi, Dec. 27, 1948, 2 ad. ♂, 1 ad. ♀.

Uttar Pradesh (United Provinces) : Benares, Jan. 23, 1947, 1 ad. ♂. Gorakhpur, Jan. 26–27, 2 ad. ♀, Jan. 29, 1 ad. ♂; Nichlaul, Feb. 6–12, 4 ad. ♂; Kalnahi, Feb. 19, 1 ad. ♂, Feb. 23, 1 ad. ♀; Malasa, April 1–4, 1948, 2 ad. ♂, 1 ad. ♀.

Bihar : Mohammadganj, Aug. 20, 1947, 1 imm. ♀, Aug. 24, 1 imm. ♂, Sept. 3, 1 ad. ♂ ; Garhwa Road, Sept. 10, 1 ad. ♂, Sept. 12, 1 imm. ♀, Sept. 21, 3 imm. ♂.

The species' range is limited to the plains of northern India between the outer Himalayas in the north and the Vindhya Hills chain in the south and from the Northwest Frontier Province to Bengal. It is extremely partial to well watered terrain and apparently the jungles to the south and east, the arid land to the west and the high mountains to the north have been sufficient barriers preventing its entering other suitable areas, particularly in southern India. Within its rather narrow range there is no evidence of geographic variation.

Specimens from Bihar, September 3, 10, and 12, are molting. The feathers of the lower back and abdomen appear to be the first body feathers renewed ; later, the upper back and throat feathers molt, preceding the feathers of the crown and chin, which are the last replaced. The fresh secondaries are narrowly edged with buff, but these lightly colored edges quickly wear.

Birds of the year, upon completing the post-juvenal molt, are indistinguishable from adults.

Measurements : Wing: ♂♂, 118 (♀?), 123·5, 124, 125, 125, 126, 127, 127, 127, 128, 128, 129, 129 ; ♀♀, 121, 121, 122, 123, 123. Tail ; ♂♂, 67 (♀ ?), 68, 69, 69, 70, 70, 70, 71, 71, 71, 73·5, 74 ; ♀♀, 64, 67, 68, 68·5, 71. Bill : ♂♂, 14 (♀ ?), 14, 14, 15, 15, 16, 70, 16, 16, 16, 16, 16, 17, 17, 17 ; ♀♀, 14, 14, 15, 15, 16, 16.

Sturnus fuscus (Wagler)

The crested mynas of the *cristatellus-fuscus-grandis* assemblage have been variously treated as including from one to three species. In a recent review of that group, Ticehurst (Stanford and Ticehurst 1937, pp. 555–557) recognized two species : *cristatellus* and *griseus*. Under the former were included the nominate mainland race, the Hainan race, *brevipennis*, and the Formosan subspecies, *formosanus*. With the Javan *griseus* were united *grandis* and *fuscus*.

Ticehurst correctly saw that *fuscus* of India, Arakan, and lower Burma, and *grandis* of Upper Burma and Siam were conspecific. There has been no evidence to show that these two forms are not strictly allopatric, and intermediates are known to occur. Ticehurst himself reports such intermediates from Maymyo, Mandalay District of Central Burma. I have examined a specimen in the Rothschild Collection (male adult, May 2, Kani, Lower Chindwin) which is very similar to *grandis*, but the lower part of the abdomen is a pale buff color, approaching *fuscus* in that respect.

The relationship between *grandis* and *cristatellus* is not as easily established because migratory movements in these two forms have tended to obscure the real limits of their breeding ranges. The evidence presented by Ticehurst does not indicate a necessary overlap of the breeding ranges, nor until now has it ever been shown that these two birds do, in fact, occur together during the breeding season and yet remain reproductively isolated.

In Tonkin and Annam, *gandis* is said to overlap with *brevipennis*, a subspecies of *cristatellus* described originally from Hainan. I have been able to find only two definite records of the two forms breeding together. Mr. Jean Delacour, although he himself was there only in winter, tells me that the two birds are very common and both breed in Annam and Tonkin. He suggests that the scarcity of breeding notes may be due to the fact that the birds are so ubiquitous about the countryside that no one has bothered to publish nidification records. Milon (1942, p. 8) states that both nest about Langson in northeastern Tonkin. S. Eaton (unpublished) collected at Poseh, Kwangsi, China, on May 2, 1945, a female of *cristatellus* ("advanced ovary ; brood patch") and a male of *grandis* (" testes enlarged") the following day.

In Yunnan, it is still uncertain that a real overlap of breeding range occurs. Mayr (Stanford and Mayr, 1941, p. 354) pointed out that the material, which according to Ticehurst demonstrated overlapping in northwestern Yunnan, represented collections made at different seasons. However, I have examined a specimen from the Myitkyina District of Northern Burma, which is apparently a hybrid between *grandis* and *cristatellus*. Of two males taken at Namaoyang (500′) April 11, 1939, one is typical *grandis* while the other exhibits characters of both that form and *cristatellus*. The latter specimen has the base of the lower mandible reddish and the undertail coverts black, like *cristatellus*, but the coverts and rectrices are broadly tipped with white, the condition in *grandis*.

Ticehurst's remark (*loc. cit.*) that in "Northern Burma *grandis* sometimes has the undertail coverts partly black but always with broad white tips, and broad white tips to the tail " may be interpreted to indicate a zone of hybridization in that area.

One must regard *cristatellus* as specifically distinct from *fuscus* (including *grandis*) although they are so closely related that their ranges are still largely allopatric and that in at least one area in Northeastern Burma there is not complete reproductive isolation.

Because *Aethiopsar* and *Acridotheres* are congeneric the name *griseus* cannot stand (Stanford and Mayr, 1941) and *fuscus* must replace it. Included as a race of *fuscus* is *grandis*.

In India it is possible to recognize two races of *fuscus*: a gray backed northern form, nominate *fuscus*, and the browner backed southern and western bird, *mahrattensis*. The material of Koelz shows the two forms to be clearly separable on the character of the color of the back alone, although it is said that the races also differ in the color of the irides[1]. Examples from Bichhia, Mandla District, Central Provinces, were too worn to assign with certainty, but two adults seem closer to *mahrattensis* and they have doubtfully been referred to that race by me.

Sálim Ali and Whistler (1936, p. 501) note that this myna had not been recorded from the Palni Hills,[2] but we now have a specimen from there.

A. f mahrattensis breeds in southern India north, along the west coast, to the latitude of Bombay City. It may prove also to be the breeding form of the northern Central Provinces. The nominate subspecies nests in northern India from Simla to Assam and eastern Bengal south to Pegu. It intergrades with *grandis* in central Burma and with *torquatus* in southern Tenasserim and northern Malaya.

Ripley (1950) has described another race of *fuscus* from Assam. The new subspecies, *fumidus* (type locality: Sadiya, northeastern Assam), is said to differ from the nominate form by being "darker, more sooty on the upperparts particularly on the rump, and darker, more smokey on the abdomen and belly." The range of *fumidus* is given as "Assam in north Cachar and north to Lakhimpur and the Mishmi Hills."

Four worn males from the Khasia Hills, which should belong to this proposed race, were compared with males in similar plumage from Nepal. The latter represent nominate *fuscus* (type locality: eastern Bengal). No constant differences which would separate the Khasia Hills and Nepalese birds were observed. Three specimens (Rothschild Collection) from Assam localities—Patkai Hills, Margherita, and 'northern Assam'—agree with the other Indian material. The distinctness of *fumidus* appears questionable.

STURNUS FUSCUS FUSCUS (Wagler)

PUNJAB: Kulu Valley, Kakinal, June 4, 1936, 1 ad. ♂.

UTTAR PRADESH (United Provinces): Kalnahi, Feb. 20, 1947, 1 ad. ♀; Khada, Feb. 26, 1 ad. ♀.

NEPAL: Simra, March 5, 1947, 1 ad. ♂; Thankot, April 2-12, 2 ad. ♂, 2 ad. ♀; Hitaura, June 16, 1 ad. ♂, July 4–15, 3 imm. ♀.

ASSAM: Khasia Hills, Umran, April 12, 1949, 1 ad. ♂; Nongpoh, April 24 May 13, 2 ad. ♂; Bara Pani, May 23, 1 ad. ♂.

BENGAL: Dacca, Jan. 14, 1937, 1 ad. ♂.

BIHAR: Raxaul, March 1, 1947, 1 ad. ♀.

MEASUREMENTS: Wing: ♂♂, 122, 122, 125, 127, 127, 127, 128, 129; ♀♀, 120, 121, 121, 124, 125. Tail: ♂♂, 72, 72, 74, 74, 74, 75.5, 76; ♀♀, 67, 71.5, 72, 74.5, 75. Bill: ♂♂, 15, 15, 15, 15, 16, 17, 17, 17.5; ♀♀, 14, 15, 15, 15, 16.

STURNUS FUSCUS MAHRATTENSIS (Sykes)

SOUTHERN BOMBAY PROVINCE: Londa, Jan. 7–25, 1938, 2 ad. ♂, 3 ad. ♀, March, 12, 1 ad. ♂; Jagalbed, March 1–4, 1 ad. ♂, 1 ad. ♀; Castle Rock, March 8, 2 ad. ♂, 1 ad. ♀.

MADRAS PROVINCE: Palni Hills, Kodaikanal, March 10, 1937, 1 ad. ♀; Nilghiri Hills, Ootacamund, Feb. 16, 1 ad. ♂.

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[1] Yellow in northern birds, grey in southern—EDS.

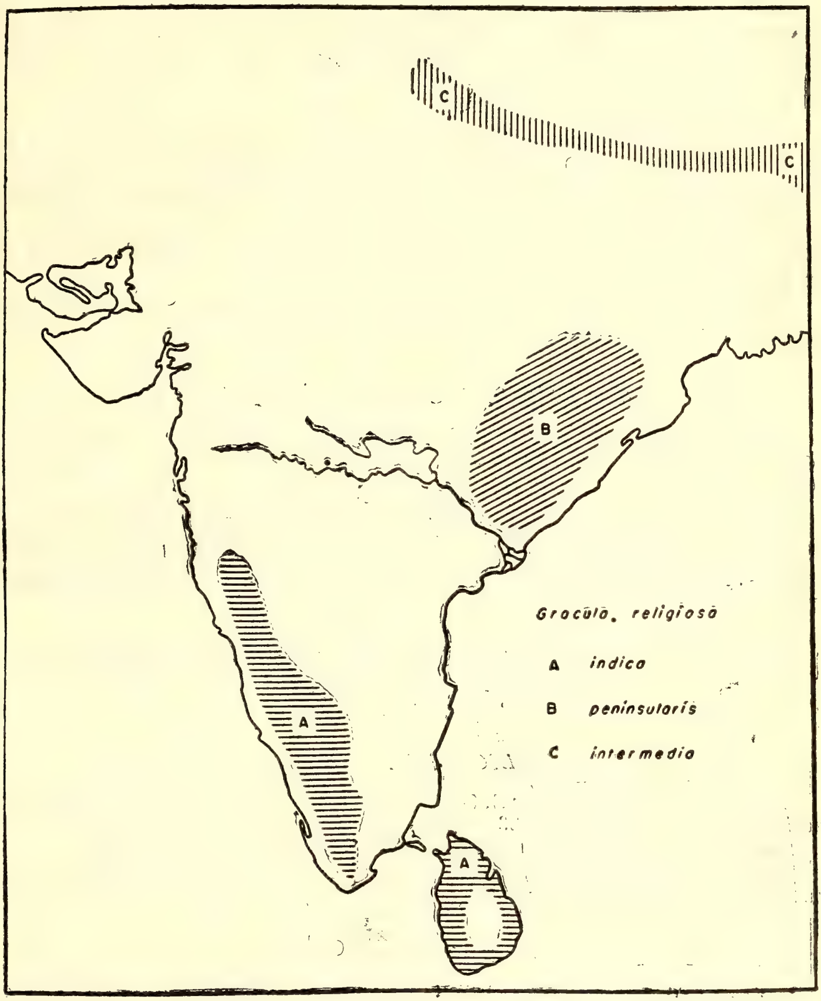
[2] Sálim Ali has since found it common at Kodaikanal (ca. 7,000 ft.) in the Palnis.—EDS.

MADHYA PRADESH (Central Provinces): Bichhia, July 4–17, 1946, 1 ad. ♂, 1 ad. ♀, 3 imm. ♀.

MEASUREMENTS: Wing: ♂♂, 127, 127, 128, 128, 128, 130, 130, 131; ♀♀, 123, 123, 124, 125, 126. Tail: ♂♂, 73, 74, 75, 76, 76.5, 76.5, 76.5, 77; ♀♀, 70, 71, 72.5, 73.5, 75. Bill: ♂♂, 15, 15, 15, 16, 16, 16, 16, 17; ♀♀, 15, 15, 15, 16, 16, 16.

Gracula religiosa Linn.

This specialized starling is widespread in the Oriental region. Representative forms are to be found in Ceylon (*G. ptilogenys*), India Malaysia, and the Greater Sunda Islands. The differences among the various subspecies, of which fourteen are recognized, are slight but constant. Variation chiefly expresses itself in general body size, bill



Distribution of *Gracula religiosa* in India.
Horizontal shading: *G. r. indica*; diagonal shading: *G. r. peninsularis*; vertical shading: *G. r. intermedia.*

length and depth, and the character of the bare skin about the head. All of the populations are isolated from each other to a greater or lesser degree; the extent of geographic isolation is perhaps nowhere more striking than on a continental land mass such as the Indian peninsula. The enormous discontinuity in range is scarcely appreciated unless one examines a map (text-fig. 1); each major region is occupied by a discrete and fairly homogeneous subspecies. Suitable areas in central India where this myna might be expected are plentiful but nevertheless it appears to be absent. No *a priori* reasons for its absence are known and field studies would seem to be indicated.

The systematics of the Indian races, of which there are three, have been adequately treated by Whistler and Kinnear (1933, pp. 585–590); the puzzling problem of *G. ptilogenys* has been analyzed by Ripley (1946, p. 237).

Baker (1926, p. 20) states that examples of this species from the South Andamans appears to belong to the nominate race, but I find that specimens in the American Museum collection from that island are not distinguishable from the north Indian race *intermedia*. The eye and cheek patches are joined in these birds and the measurements are those of the smaller race. A specimen from Great Nicobar seems not to differ from nominate *religiosa*.

There is no evidence of a regular period of molt and birds in all stages of molt may be found throughout the year.

GRACULA RELIGIOSA INDICA (Cuvier)

SOUTHERN BOMBAY PROVINCE: Londa, Feb. 3, 1938, 1 ad. ♂, Feb. 8, 2 ad. ♂, 1 ad. ♀, Feb. 9, 1 ad. ♂, Feb. 16, 1 ad. ♂, March 11–12, 2 ad. ♂; Jagalbed, Feb. 18–26, 3 ad. ♂, 2 ad. ♀; Supa, Feb. 27, 1 ad. ♂.

MEASUREMENTS: Wing: ♂♂, 139, 139, 140, 141, 142, 143.5, 144, 144, 145, 145, 145; ♀, 141. Tail: ♂♂, 62, 62.5, 65, 65, 66.5, 67, 67, 67, 68, 68, 69.5, 70; ♀, 64.5. Bill: ♂♂, 17, 18, 18, 18.5, 19, 19, 19, 19, 19, 19, 19, 20; ♀♀, 18, 19. Freshly molted specimens in the A.M.N.H. collection are 8–13 mm. longer in the wing and 1–3 mm. longer in the tail.

GRACULA RELIGIOSA PENINSULARIS Whistler & Kinnear

BASTAR: Taroki, March 20, 1949, 1 ad. ♂, 1 ad. ♀.

GRACULA RELIGIOSA INTERMEDIA A. Hay

NEPAL: Amlekhganj, March 9–10, 1947, 2 ad. ♂, 1 ad. ♀; Hitaura, May 20–25, ad. ♀, June 13, 1 ad, ♂, June 23, 1 imm. ♂.

ASSAM: Khasia Hills, Nongpoh, April 24–28, 1949, 3 ad. ♂, 2 ad. ♀.

MEASUREMENTS: Wing: ♂♂, 166, 167, 176; ♀, 163. Tail: ♂♂, 75, 78, 85; ♀ 80. Bill: ♂♂, 18, 19, 19, 19·5; ♀♀, 19, 20, 20·5.

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ON A COLLECTION OF BUTTERFLIES FROM THE BALIPARA FRONTIER TRACT AND THE SUBANSIRI AREA (NORTHERN ASSAM)

BY

F. N. Betts

(*With a sketch map*)

These notes are based on a collection made while I was Political Officer in this district during 1946/48. The collection has now been presented to the British Museum. I did not have time to work it out very thoroughly myself and it is therefore possible that there are some inaccuracies.

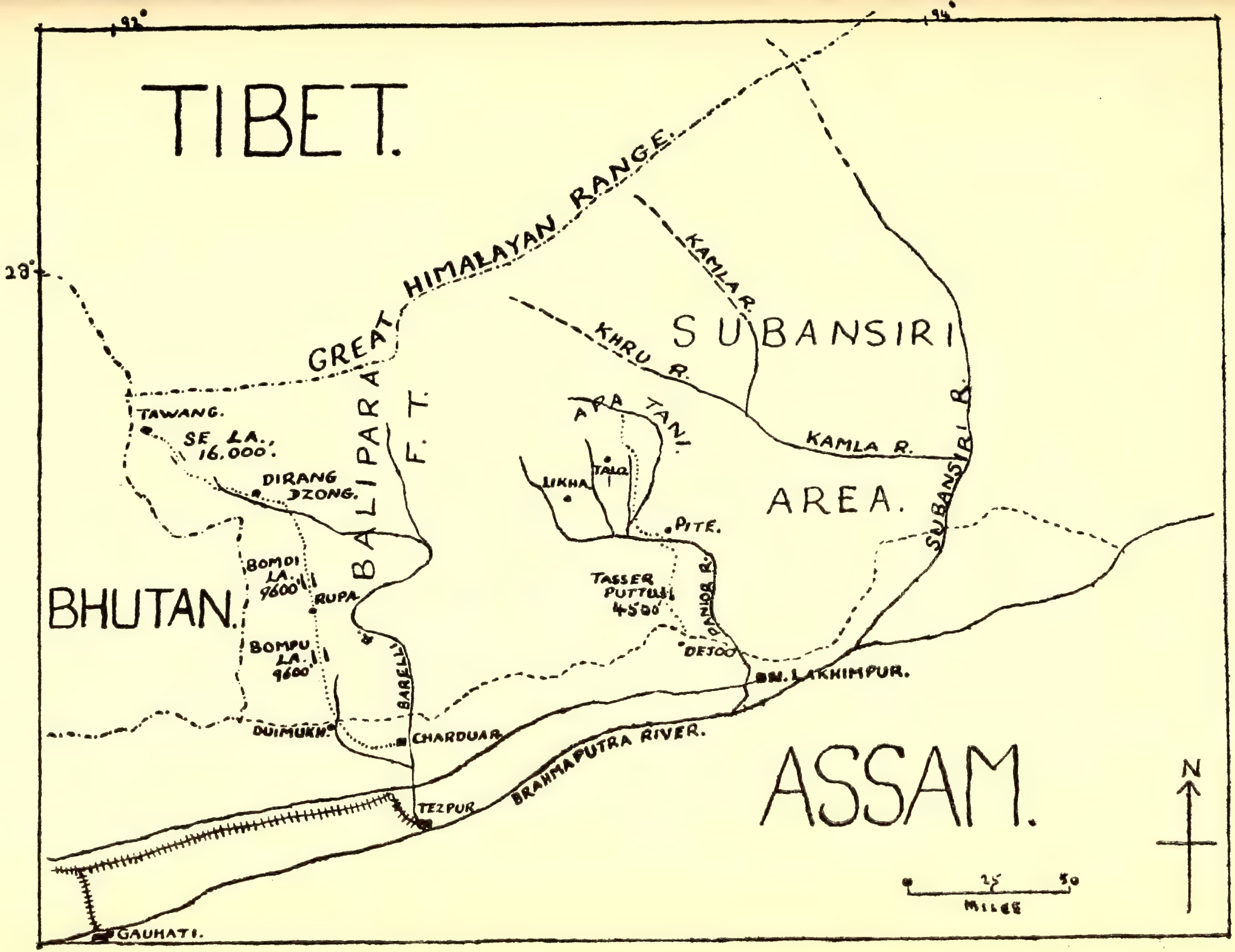
The area worked extends from the plains on the south to the main Himalayan Range, forming the undemarcated boundary of India on the north. The western border is formed by the Bhutan Frontier, and the eastern by the Subansiri River, which, running almost due south after breaking through the Himalayas, emerges into the Assam plain a few miles east of N. Lakhimpur.

The western portion of the district along the Bhutan border is fairly well known as there is a regular trade route into Tibet via Tawang over the 14,000′ Se La pass. The inhabitants, Momba and Sherdukpen are of Tibeto-Bhutanese extraction and comparatively civilised and have been administered up to the Tibetan frontier for a considerable time. Far the greater part of the district however is a wild, and tangled complex of forest covered hills, sparsely inhabited by completely savage and extremely unfriendly tribes, mostly lumped together under the name of Daflas. Penetration and administration was only attempted in 1946, and a point some sixty miles into the foothills has been reached, but still a vast area of the basins of the rivers Khru, Kamala, and Subansiri have never been seen by a foreign eye.

The topography shows a belt of foothill ranges, 100 miles or more in depth, running mainly east and west, though there are several cross chains forming watersheds between the main rivers. The outer range bordering the plains varies from 4000′ to 12,000′ in height and rises extremely steeply. The rainfall on the south face must be among the heaviest in the world, and the hills are covered from base to crest in dense evergreen rain forest. The inner ranges rise gradually in height but experience a much drier climate.

On the west after crossing the Bompu La, 9,600′, the vegetation immediately changes to a palaearctic type, pines and deciduous oaks and other hardwoods. On the east where the outer wall is lower, the semi-tropical evergreen rain forest extends much further north.

A feature of the country is the way in which the main rivers have cut back enormously deep gorges almost to the foot of the snow ranges so that along their banks the 2/3,000′ contour line extends very far


92°
94°
28°
TIBET.
GREAT HIMALAYAN RANGE.
KAMLA R.
KHRU R.
SUBANSIRI
AREA.
SUBANSIRI R.
KAMLA R.
APA TANI.
TALO.
LIKHA
PITE.
TASSER PUTTU 4500
PANIOR R.
DEJOO
N. LAKHIMPUR.
TAWANG.
SE LA., 16,000.
DIRANG DZONG.
BALIPARA F. T.
BOMDI LA. 9600
RUPA
BOMPU LA. 9600
BARELI R.
BHUTAN.
DUIMUKH.
CHARDUAR.
TEZPUR
BRAHMAPUTRA RIVER.
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0
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MILES

Balipara Frontier Tract and Subansiri Area—N. Assam.

north and allows a prolonged incursion of subtropical flora. On account of their ignorance of the art of weaving and making clothing the tribes cling to the warmer valleys to a height of 4/5,000′ only, and live by hunting and *jhum* cultivation, a system by which forest is felled and burned and one or two crops taken before moving on elsewhere. In the more thickly settled areas this has resulted in permanent deforestation, and the appearance of wide stretches of scrub and coarse grassland.

Special mention must be made of one tract though it is but twenty square miles in area. The Apa Tani valley is an old lake bed, lying at an elevation of 5,000′, surrounded by a ring of forested hills 2,000′ higher. The tribe, whose origin is unknown, are entirely different from any of their Dafla or Miri neighbours, and while still in a neolithic state of culture, have developed a system of intensive, permanent agriculture which must be unique, and which for unknown generations has enabled them to maintain a population of 1000 to the square mile entirely self-sufficient except for salt. Every inch of the flat land of the valley is under irrigated paddy or millet, and they cultivate plantations of *Pinus excelsa* and a peculiar type of bamboo for building purposes, neither of which is found in a natural state within a very great distance. This little patch of highly developed cultivated land in the middle of a vast expanse of forest has produced a fauna of its own, and in the bamboo groves in particular I found several species of butterflies which I saw nowhere else.

In the following list dates given are those in which specimens were taken, not necessarily the only times when they were on the wing.

1. **Troides a. aeacus** Fd.

Sept/Oct. Fairly common at low elevations along roads and rivers in tropical evergreen forest.

2. **Polydorus varuna** Wd.

July/Aug. Widely spread but not numerous. Most common after the monsoon in secondary forest along rivers at low elevation but one specimen taken at 5,000′ in open country in the Apa Tani valley.

3. **Polydorus l. latreillei** Don.

Aug. Apa Tani valley, 5,000′. Only once taken in river bed.

4. **Polydorus philoxenus** Db.

Apr./Sept. Occurred scarcely along rivers at low elevations in tropical forest, but was extremely common and the specimens much larger in the temperate Momba country. Here it was found in the oak woods and drinking at patches of wet sand in the river beds, and was one of the few Papilionids occurring. A larva which pupated on 1-12-46 hatched on 17-4-47. It turned out an extremely dwarf specimen though perfectly formed. This was probably due to starvation as I was unable to obtain a supply of the food plant.

5. **Polydorus aidoneus** Db.

July. Dejoo, 500′. Rare ; only once taken on the plains in secondary forest.

6. **Chilasa agestor** Gray.

Feb./June. Pite, 2,000′. Not common. Single specimens feeding with other Papilionids on wet river sand.

7. **Chilasa clytea** Evans.

Aug. Sadiya, 200′. A plains species never seen in the hills.

8. **Chilasa epycides epycides** Hew.

Apr. Likha 3,500′. Secondary scrub. Once taken.

9. **Papilio protenor** Fruh.

Aug. Pite, 2,000′, Talo 4,500′. Moderately common on river sand at low elevations. The specimen taken at Talo in cultivation must have been a stray as I never saw another as high as this.

10. **Papilio rhetenor** Wd.

May, Aug. Kore 4,000′, Pite 2,000′. Scarce. One taken in secondary scrub in hills, and one on river sand.

11. **Papilio polyctor ganesa** M.

April/Sept. Likha 4,000′, Rahung 5,000′. Scarce. A hill species. Two taken at buffalo wallow in evergreen forest area, one at river sand in temperate oak and pine zone.

12. **Papilio paris** L.

Apr./May, Aug./Sept. After *P. helenus* probably the commonest of the genus, and the most widely spread. Taken in forest plentifully from plains level up to 5,000′ in the evergreen belt, but not in the oak/pine country.

13. **Papilio castor** Wd.

May, Aug., Sept. Sadiya, Doimara, Pite, up to 2,000′. Not uncommon, a plains species.

14. **Papilio helenus** L.

Quite the commonest Papilio and flies longer than any other. Taken in every month between Feb. and Oct. from plains level up to 4,000′ in tropical evergreen country.

15. **Papilio chaon** Wd.

Sept. Doimara, 1,000′. Scarce. Only taken once on river sand at foot of the hills.

16. **Papilio polytes romulus**

Very common indeed in the open cultivated country of the plains but not seen in the hills nor in the foothill forests.

17. **Papilio demoleus** L.

Distribution as last. Both are minor pests on *Citrus*.

18. **Graphium agetes** Wd.

May. Likha, 3,500′. Taken only at this one locality where it was not uncommon at a buffalo wallow in evergreen country.

19. **Graphium antiphates pompilius** F.

May/Aug. Dejoo, Pite up to 2,000′. Swarms on patches of wet river sand at low elevations in company with the various Graphiums but never so numerous as they.

20. **Graphium cloanthus** Wd.

Aug./Sept. Pite 2,000′, Likha 3,500′, Apa Tani 5,000′, Rahung 6,000′. Not common mostly seen at 5,000′ and above. The only Graphium seen in the temperate zone.

21. **Graphium sarpedon** L.

22. **Graphium doson axion** Fd.

23. **Graphium bathycles chiron** Wall.

All three species fly together and swarm in immense numbers on wet river sand at low elevations between April/Oct.

24. **Graphium a. agamemnon** L.

July/Oct. Pite, Doimara, Duimukh. Taken at low elevations only up to 2,000′. Much scarcer than the other Graphiums and usually solitary, one or two being seen among the myriads of other species on sand patches.

25. **Lamproptera c. curius** F.

Aug. Ptie, 2,000′. Sadiya 250′. Common on river sand though usually singletons.

26. **Armandia l. lidderdalei** Atk.

Sept. Rahung, 7,000′. Extremely local and was only seen in this one spot. Even here it was confined to a narrow belt between 7/7,500′ just below the line of the evergreen forest crowning the hill. They were numerous, floating high to and fro among the scattered oaks and rarely settling. Despite their fragile build they were on the wing in dark, wet, misty weather when practically no other butterflies were to be seen.

27. **Pieris canidia** Evans.

May. Kore, Duta, 5,000′. Common in open country at fairly high elevations.

28. **Pieris brassicae** L.

Sept. Lih, 7,000′. Very common in the temperate valleys of the Momba country.

29. **Delias belladonna** Jerd.

April, Sept. Likha, Yatchuli, 3/3,500′. Not common, but widely spread. Flies in grass and open secondary forest. Usually single.

30. **Delias aglaia** L.

Oct. Doimara, 1,500′. Not common. A low elevation species found in secondary forest.

31. **Prioneris thestylis** Db.

Feb, Nov., Dodo Seram, 2,500′, Pite 2,000′. Not common. Grassy meadows near rivers.

32. **Cepora nadina nadina** Luc.

April, July. Lichi 2,500′, Dejoo 250′. Common in secondary forest along rivers at low elevations.

33. **Cepora nerissa** F.

May. Likha, 3,500′. Secondary forest. Not common.

34. **Appias lalage lalage** Db.

Feb., May, Oct. Kore 5,000′, Pite 2,000′. Common in open country and secondary forest with a wide range of elevation and season.

35. **Appias indra indra** M.

May. Lichi, 2,500′. Secondary forest.

36. **Appias lyncida hippoides** M.

May, Aug. Lichi 2,500′, Apa Tani 5,000′. The commonest of the genus.

37. **Catopsilia crocale** Cr.

Aug. Doimara, Apa Tani. Common at all elevations up to 6,000′ and found almost everywhere from evergreen forest to open cultivation.

38. **Colias electo field** Men.

Apa Tani 5,000′, Rupa 6,000′. Common in grassy meadows at high elevations.

39. **Ixias pyrene pirenassa** Wall.

Nov. Dodo Seram, 2,500′ Riverside meadows.

40. **Ixias pyrene latifasciatus** But.

Aug. Pite 2,000′, Apa Tani 5,000′. Widely spread in open country.

41. **Hebomoia glaucippe** L.

May/Sept. Dejoo 250′, Pite 2,000′. Very common at low elevations. along the banks of rivers in tropical forest. Comes down to wet sand patches.

42. **Pareronia avatar avatar** R.

Foothills Camp, 1,500′. Aug. Very local. Only seen here in the interior of heavy forest where it was common.

43. **Danais aglea melanoides** M.

July/Aug. Apa Tani 5,000′, Dejoo 250′. Common from plains to about 6,000′ in fairly open country and cultivation,

44. **Danais plexippus** L.

July/Sept. Dejoo, Doimara. Very common up to 2,000′ in fairly open country.

45. **Danais melissa septentrionis** But.

Aug/Nov. Pite 2,000′. Open woodland at low elevations.

46. **Danais tytia tytia** Gray.

May. Kore, 5,000′. Scarce. Only seen at 5,000′ and above.

47. **Danais melaneus plateniston** Fruh.

Nov. Pite, 2,000′. River sand. Scarce.

48. **Euploea m. mulciber** Cr.

July/Aug. Dejoo, Yatchuli, Kore. Common at all elevations up to 6,000′ in fairly open country and forest clearings.

49. **Euploea diocletiana diocletiana** F.

July/Aug. Dejoo, Charduar, 500′. Extremely common in open forest and along forest roads on the plains but does not ascend the hills at all.

50. **Mycalesis visala visala** M.

Sept. Rahung, 5,000′. Common in grass meadows and cultivation in the temperate Momba country.

51. **Mycalesis malsarida** But.

July. Dejoo, 250′, Lichi 2,500′. Interior of evergreen forest. Once at Duta, 5,000′ in open cultivation.

52. **Mycalesis francisca sanatana** M.

Oct. Pite, 2,000′ Bamboo jungle.

53. **Mycalesis malsara** M.

Feb, May. Pite 2,000′, Yatchuli 3,500′. Bamboo jungle.

54. **Lethe c. confusa** Aur.

Aug/Oct. Pite, 2,000′ secondary tropical forest; Yatchuli, 3,000′, thatch grass and deciduous woodland; Bomdi La, 8,000′, coniferous forest; Nyukmadong, 9,000′, oak woods. A common species with an enormous range of altitude and habitat. Especially fond of isolated trees in grassland settling on the trunks.

55. **Lethe yama yama** M.

May. Apa Tani, 6,000′. Scarce. In the interior of dense evergreen forest, with bamboo undergrowth. Settles on the ground among the dead leaves where it is exceedingly hard to see.

56. **Lethe bhadra** M.

May, Oct. Tasser Puttu, 4,000′. Apa Tani, 6,000′, Bompu La, 9,000′.

Similar in habits to *L. yama* but much commoner.

57. **Lethe rohria** F.

Oct. Yatchuli, 3,000′. Hill sides covered with long grass.

58. **Lethe verma sintica** Fruh.

Oct. Lih, 7,000′, But, 6,000′. The Momba country above 5,000′. Flies among oaks on grassy hill sides.

59. **Lethe sidonis vaivarta** Doh.

Oct. Bompu La, 9,500′. Extremely local and only seen on the summit of the Bompu and Bomdi Las, where it was flying in bamboo scrub at over 9,000′ and was the only butterfly taken at that height.

60. **Lethe visrava** M.

Oct. Tasser Puttu, 4,500′. Only taken here in undergrowth in dense evergreen forest.

61. **Lethe bhairava** M.

Oct. Tasser Puttu, 4,500′. As *L. visrava* in habits. Rare.

62. **Lethe scanda** M.

Oct. Tasser Puttu, 4,500′. As the last two species in habits. Only taken with them in this one locality.

63. **Lethe latiaris** Hew.

July. Apa Tani, 5,000′. Cultivation. Rare.

64. **Lethe kansa** M.

May. Tasser Puttu, 4,500′. Dense rain forest. Scarce.

65. **Lethe vindhya** Pd.

Oct. Selsemchi, 1,500′. Evergreen forest at low elevations. Rare.

66. **Lethe serbonis serbonis** Hew.

Sept. Bomdi La. Interior evergreen forest, 7,000′. Only seen here.

67. **Lethe sinorix** Hew.

Aug. Once taken at Pite, 3,000′, in bamboo forest.

68. **Lethe chandica flanona** Fruh.

Oct. Tasser Puttu, 4,500′. Yazali 3,000′. Evergreen forest.

69. **Lethe sura** Db.

Sept. Bompu La,Bomdi La 8/9,000′. Common in scrub bamboo on the tops of the passes.

70. **Lethe distans ?**

May/Oct. Apa Tani. This butterfly I was unable to identify, but appears closest to *distans*, being distinguished by the orange red patch on the hindwing. It was one of the species confined to the cultivated bamboo groves of the Ape Tani plateau. It flew up and down the narrow fenced alleys between the plantations, and was common here but nowhere else seen.

71. **Lethe goalpara goalpara** M.

Sept/Oct. Bomdi La, 9,000′. Flying with *L. sura* in scrub bamboo but not numerous.

72. **Orinoma damaris** Gray.

July, Oct., Pite, 2,500′, Yatchuli 3,500′. Only twice taken in secondary forest.

73. **Aulocera brahminus dohwana** Evans.

74. **Aulocera swaha swaha** Koll.

75. **Aulocera padma loha** Doh.

Sept. All three were common on the grassy alps of the Momba country from 6/10,000′. *A. brahminus* appeared to range the highest.

76. **Erebia annada orixa** M.

Rupa, 5,000′. Sept. Common in grassland in sheltered valleys in the temperate Momba country.

77. **Yphthima sakra austeni** M.

Aug/Sept., 5/7,000′. Habits as the last species. Common in the Momba country, but also taken on the Apa Tani plateau in cultivated land.

78. **Yphthima narada newara** M.

Sept. Lih, 7,000′. Grassland in the Momba country. Fairly common.

79. **Zipoetis scylax** Hew.

May, Sept. Tasser Puttu, 3,500′; Pite, 2,000′. Undergrowth of evergreen and bamboo forest. Scarce.

80. **Orsotrioena m. medus** F.

Sept. Doimara, 1,500′. Undergrowth secondary forest at low elevations.

81. **Ragadia crisilda crito** d'N.

July, Oct. Tassar Puttu, 4,500′. Undergrowth of evergreen forest. Rare.

82. **Anadebis himachala** M.

April/Oct. Pite, 2,000′; Lichi, 3,000′. Undergrowth of evergreen and bamboo forest. Fairly common.

83. **Melanitis leda ismene** Cr.

84. **Melanitis z. zitenius** Herbat.

85. **Melanitis phedima bela** M.

May/Oct. Extremely comon in forest everywhere with the exception of *M. bela* which is scarce. Habits of all three similar. They sit on the ground among dead leaves, and when disturbed fly off rapidly and settle again, and immediately disappear.

86. **Cyllogenes suradeva** M.

Sept. Bompu La, 7,000′. Interior evergreen forest. Rare.

87. **Neorina hilda** Wd.

Aug/Sept. Apa Tani, 6,000′. Bompu La, 8,000′. Interior of evergreen forest at high elevations only. Scarce.

88. **Elymnias patna patna** Wd.

Apr/Nov. Pite, 2,000′; Selsemchi, 1,500′. Open secondary forest at low elevations. A stray both as regards season and locality was taken at Duta, 5,000′, on Dec. 2nd.

89. **Faunis eumeus assama** Wd.

Oct. Pite, 1,500′. Scarce. Interior of dark evergreen forest. Was taken in very dull, wet weather. The butterfly sits on dead tree trunks where it is very hard to see, and flies off swiftly dodging through the undergrowth and resettles abruptly, making it very hard to mark.

90. **Aemona amathusa** Hew.

Aug. Tasser Puttu, 4,500′. Scarce. Habits similar to *Faunis eumeus.*

91. **Sticophthalma camadeva.**

Sept. Pite 2,000′. Bamboo forest at low elevations. Seen but no specimen taken.

92. **Sticopthalma nourmahal nurinissa** d'N.

July. Aug. Apa Tani, 5,000′. This was another butterfly confined to the Apa Tani cultivated bamboo groves. It was common in these for a few weeks, and could almost always be taken as it settled on the dried bamboo fences dividing the gardens. I never saw it in the forest in wild bamboo.

93. **Sticopthalma sparta tytleri** Roth.

July. Rare. Taken in the Apa Tani bamboo groves but only in small numbers. It was also seen in wild bamboo forest in the neighbourhood. On one occasion a very ancient and tattered specimen passed me, so old and weak that it could hardly fly. As it sank to the ground, it was set upon and killed by a hornet.

94. **Thaumantis diores** Db.

Dejoo, 1,000′; Tasser Puttu, 4,000′. Fairly common in the darkest and dampest undergrowth of dense rain forest. Usually seen on dull, wet days, when it may be flushed from dead leaves in the undergrowth, to flop a few yards and settle again.

95. **Discophora c. continentalis** Stg.

July. Pite, 1,500′. Low elevation bamboo jungle. Scarce.

96. **Discophora tullia zal** Wd.

Oct. N. Lakhimpur, 500′. Once taken. It came into the Dak bungalow to lamplight at 10 p. m.

97. **Enispe euthymius** Db.

July, Oct. Pite, 2,000′, Tasser Puttu, 3,000′. Scarce. Bamboo forest.

Charaxes, *Eriboea*, *Apatura*. All robust, strong flying species spending most of their time settled on or flying round the tops of high trees, and extremely difficult to catch at such times. They are however, particularly the males, strongly attracted to dung, carrion, or sap exudations and most captures are made this way. Wet sand also attracts but to a lesser extent.

98. **Charaxes marmax** Wd.

Oct. Pite, 1,500′. Not uncommon at low elevations.

99. **Charaxes polyxena psaphon** Wd.

May/July. Dejoo 50′ ; Pite, 1,500′. Fairly common.

100. **Charaxes polyxena hierax** Fd.

As *C. p. psaphon.*

101. **Eriboea dolon.**

Apa Tani, 5,000′. Aug. Not taken but frequently seen travelling high and fast across open country.

102. **Eriboea delphis ?**

Aug. Talo 4,000′. Believed seen once but just missed capture.

103. **Eriboea a. athamas** Dr.

May/Aug. Very common at all elevations to 5,000′ in tropical forest clearings. It swarms along forest rivers, collecting on lumps of otter dung in hundreds, just as the Graphiums do on wet sand.

104. **Apatura ambica ambica** Coll.

May, Aug., Nov. Very common along forest rivers at low elevations. Swarms to lumps of dung or carrion as last species.

105. **Apatura chevana** M.

Oct. Pite, 2,000′. Rare, only once taken on river sand.

106. **Apatura p. parisatis** Wd.

May, July. Fairly common along rivers in forest and in the forest itself at elevations up to 3,000′.

107. **Herona marathus marathus** Db.

May, Oct. Pite, 2,000′, Apa Tani 5,000′. Open woodland with bamboo. Not common.

108. **Sephisa chandra** M.

Aug., Oct. Pite, 2,000′. Scarce. Two specimens taken on river sand.

109. **Diagora persimilis zella** But.

Aug. Pite, 2,000′. Scarce. Two specimens taken on river sand.

110. **Euripus halitherses** Db. & Hew.

Oct. Dejoo 1,000′, Males not uncommon at low elevations in secondary scrub. Females never seen.

111. **Hestina nama** Db.

Oct. Pite, 2,000′. River sand. Fairly common along rivers at low elevations.

112. **Calinaga buddha buddha** M.

Apr., Pite, 2,000′. Rare. Only once seen.

113. **Dichorrhagia nesimachus** Bdv.

Feb./May. Pite, 2,000′, Lichi 2,500′. Fairly common up to 4,000′. Usually seen singly. Fond of settling on tree trunks.

114. **Stibochiana n. nicea** Gray.

May, Sept. Pite, Lichi, 2/3,000′; Rupa, 5,000′. Common. Obtained both in evergreen tropical forest and temperate oak woods.

115. **Euthalia jahnu jahnu** M.

Oct/Nov. Pite, 2,000′. River sand. Only one specimen seen.

116. **Euthalia lubentina indica** Fruh.

Oct. Pite, 2,000′. River sand. Scarce.

117. **Euthalia telchinia** Men.

Oct/Nov. Pite, 2,000′; Tasser Puttu, 4,000′. Dense evergreen jungle. Scarce.

118. **Euthalia duda** Stg.

Apr. Pite, tropical bamboo forest. Once obtained. Aug., Apa Tan., dense evergreen forest, fairly common.

119. **Euthalia s. sahadeva** M.

July/Aug. Apa Tani, 6,000′, dense evergreen forest. Only seen here flying with last species but locally common.

120. **Euthalia julii appiades** Mon.

Oct. Doimara, 1,500′. Tropical plains forest. Common.

121. **Euthalia f. franciae** Gray.

Oct. Lichi, 3,500′. Evergreen forest. Only specimen seen.

122. **Euthalia phemius** Db. & Hew.

Aug. Sadiya, 250′. Tropical plains forest.

123. **Adolias khasiana** Swin.

May, Likha, 3,000′. Buffalo wallow in secondary forest. Scarce.

124. **Adolias cyanipardus** But.

Aug. Lichi, 3,000′. Evergreen forest. Only specimen seen.

125. **Neurosigma d. doubledayi** Wd.

Oct. Tasser Puttu, 4,000′. Dense evergreen forest. Only two seen.

126. **Limenitis zayla** Db. & Hew.

July/Aug. Apa Tani, 6,000′. Dense evergreen forest. In company with *Euthalia duda* and *sahadeva.* Common locally here but seen nowhere else.

127. **Limenitis daraxa** Db. & Hew.

Sept/Oct. Pite, 2,000′. River rocks. Particularly common on Apa Tani plateau sunning on rocks in streams in open country.

128. **Limenitis a. austenia** M.

June/Sept. Only twice seen. Apa Tani, 6,000′, in bamboo gardens. Doimara, 1,500′, tropical evergreen forest.

129. **Limenitis p. procris** Cr.

July/Aug. Pite, Charduar, Dejoo. Very common on roads and rivers in tropical forest up to 2,000′.

130. **Pantoporia r. ranga** M.

July/Oct. Pite, Doimara. Fairly common at low elevations in tropical forest up to 2,000′.

131. **Pantoporia a. asura** M.

Aug/Oct. Pite, 2000′. Apa Tani, 6,000′. River rocks in open country.

132. **Pantoporia perius** L.

Sept. Rupa, Rahung, 5,000′. Only seen in temperate oak woods where common.

133. **Neptis columella ophiana** M.

Dejoo, 250′. Common, plains forest clearings.

134. **Neptis sankara quilta** Swin.

Sept., Rahung, 5,000′; Nyukmadong, 8,000′. Common on alpine meadows.

135. **Neptis r. radha** M.

Nov., Pite, 2,000′. River rocks. Once only.

136. **Cyrestis thyodamas thyodamas** Bdv.

May/Sept. Common everywhere from plains up to 6,000′, on Apa Tani Plateau and temperate Momba country.

137. **Chersonesia risa** Db. & Hew.

July/Oct. Secondary forest to 3,000′, Lichi, Pite. Fairly common.

138. **Pseudergolis wedah** Koll.

Sept., Kudum, Rahung, 5,000/6,000′. Temperate oak woods. Common.

139. **Rhinopalpa polynice burmana** Fruh.

Aug., Dejoo; 250′. River beds and roads in plains jungle, fairly common for a few weeks.

140. **Doleschallia bisaltide indica** M.

Oct/Nov., Pite, Dodo Seram, 2/3,000′. Fairly common along rivers in bamboo forest.

141. **Kallima inachus inachus** Bdv.

Feb/Nov. Common. Mostly in fairly low elevation forest, but taken in the Apa Tani woods at 6,000.′

142. **Kallima alompra** M.

July/Aug. Apa Tani, 6,000′. Evergreen forest. The only place seen. Locally common. Comes to a bait of carrion or rotten fruit.

143. **Precis hierta hierta** F.

Aug., Charduar, 200′. A plains species; very common.

144. **Precis orithya ocyale** Hub.

May/Dec. Jorum, 4,000′. Kore 5,000′. Very common in open cultivated land.

145. **Precis atlites** L.

Sept/Oct, Dejoo 200′. Apa Tani 6,000′. Common at all elevations from plains to 6,000′ in open country.

146. **Precis iphita iphita** Cr.

May/Sept. Dejoo 50′, Apa Tani 5,000′. Rahung 7,000′. Very common in open country and secondary scrub at all elevations both in the Assam zone, and the Momba country.

147. **Precis almana almana** L.

As *P. iphita*

148. **Vanessa cardui** L.

Sept., Apa Tani and Momba country. Meadows. 5/8,000′.

149. **Vanessa indica nubicola** Fruh.

As *V. cardui.*

150. **Vanessa kashmirensis aesis** Fruh.

As *V. cardui* but in temperate Momba country only.

151. **Vanessa canace.**

June/Nov. Not uncommon from 2,000′ up to 6,000′ along rivers and in open country. Nearly always single, and quite the wariest of all our butterflies, and I never succeeded in taking one.

152. **Symbrenthia hippoclus khasiana** M.

May/Oct., Lichi 3,000′, Apa Tani 5,000′. Secondary scrub.

153. **Symbrenthia hypselis cotanda** M.

May. Lichi. 2,500′. River rocks. Fairly common.

154. **Symbrenthia nyphanda nyphanda** M.

May, Lichi, 2,500′. River rocks. Not as common as *S. hypselis.*

155. **Argynnis h. hyperbius** L.

Aug/Dec. All over Dafla and Apa Tani country from 3/6,000′ in open grassland. Very common.

156. **Argynnis c. childreni** Gray.

May/Nov. Similar habitat to *A. hyperbius* but much scarcer.

157. **Atella phalanta** Drury.

June, Joram, 4,000′. Paddyfields. Only one ever seen.

158. **Issoria s. sinha** Koll.

June/July. Pite 2,000′, Dejoo 250′. Secondary scrub at low elevations.

159. **Cynthia e. erota** F.

June/Sept. Dejoo 250′, Apa Tani 6,000′, Rupa 6,000′. Very common at all elevations up to 6,000′ both in plains tropical forest and the Momba oak woods.

160. **Cirrochroa a. aoris** Bd.

July/Aug. Plains and foothills up to 3,000′, Pite. Very common in secondary forest and open scrub.

161. **Cirrochroa tyche mytila** M.

Feb/May. Pite 2,000′, secondary scrub. Hapulia, 6,000′, bracken clad downland.

162. **Cethosia cyane** Drury.

July, Lichi, 3,000′, secondary scrub. Not very common.

163. **Cethosia biblis ticamena.**

July/Oct. Fairly common at all elevations up to 4,000′ in fairly open country.

164. **Zemeros flegyas indicus** Fruh.

May/Oct., Dejoo 1,500′, Lichi 3,500′. Kore 5,000′. Secondary scrub. Very common.

165. **Dodona egeon** Db.

July, Pite. River sand 2,000′. Only one seen.

166. **Dodona ouida ouida** M.

Sept. Rahung, 8,000′. Temperate oak forest. Only one seen.

167. **Libythea myrrha sanguinalis** Fruh.

Feb. Pite, 2,000′. River sand.

168. **Abisara fylla** Db.

July/Oct. Pite 1,500′. Bamboo forest; Bompu La, 6,000′, evergreen forest. Common.

169. **Abisara neophron neophron** Hew.

April/May, Likha, 3,500′. Kore 5,000′. Cultivation in scrub.

WILSON'S STORM-PETRELS, SHEARWATERS AND OTHER SEABIRDS IN THE GULF OF ADEN & INDIAN OCEAN

BY

W. W. A. PHILLIPS

I have been greatly interested in Mr. C. A. Gibson-Hill's papers and Mr. Bryson's letter (*J.B.N.H.S.* Vol. 48. No. 2) on Wilson's Storm Petrel, and other oceanic birds in the Gulf of Aden and Indian Ocean.

On two recent voyages, I have kept very careful notes of the birds seen at sea between Colombo and Aden. These observations are, I think, not without interest as they show very clearly the changes in distribution that take place in some of our oceanic forms in the summer and in the winter months. The homeward voyage, 11th to 19th July (1949) was chiefly remarkable for the large numbers of Wilson's Petrels in the Gulf of Aden and an interesting flight of Sooty Terns (*Sterna fuscata*) on the 18th July, while the outward voyage, from 13th to 19th January (1950) for the complete absence of any kind of petrel and the scarcity of shearwaters. Presumably, the petrels and many of the shearwaters had migrated and were in their breeding haunts in the Southern Hemisphere in January. It would certainly appear probable that, as Mr. Bryson suggests, the Wilson's Petrels that he saw in the Cape Guardafui area on 21st November, 1945 were gathering before proceeding south.

The following are extracts from my diaries of the two voyages.

M. V. 'WORCESTERSHIRE. *Homeward voyage. July, 11th to 19th* 1949.

Speed normally approximately 14 knots, reduced at times to 9 knots owing to head-winds in Indian Ocean.

July 11th 1949. *Indian Ocean.* Sailed from Colombo at 2.30 p.m. Immediately after leaving harbour, a single Large Crested Sea Tern (*Sterna bergii velox*) crossed our bows flying south. These terns are now nesting in large numbers on a rocky islet about 60 miles south of Colombo.

While still within sight of Colombo we passed a single, small, white-rumped blackish petrel flying close above the water—most probably a Wilson's Storm-Petrel (*Oceanites oceanicus*); also 12 to 18 medium sized shearwaters—dark chocolate brown above and very little lighter below; darker on the primaries when seen in a good light but most of them were some distance away, flying close over the water, wheeling occasionally and moving in open order in a scattered flock.

They appeared to be the Wedge-tailed or Green-billed Shearwater (*Puffinus pacificus*) but might possibly have been the Pale-footed Shearwaters (*Puffinus carneipes*).

July 12th 1949. *Indian Ocean.* Sea moderately rough; wind strong, from S. W. 9.00 a.m. A single shearwater crossed our bows—almost certainly a Wedge-tailed Shearwater.

9.30 a.m. Three Shearwaters (Wedge-tailed) passing flying southwards.

12 NOON: SHIP'S POSITION LAT. 7° 17′ N., LONG. 75° 18′ E.

2.05 p.m. A single shearwater (same species); 3.45 p.m. another shearwater (same species) flying south-west at very much the same speed as the ship. I was very surprised to see so many shearwaters off Colombo, early in July.

July 13th. Indian Ocean. Sea moderate, wind strong. No birds seen.

12 NOON: SHIP'S POSITION LAT. 7° 22′ N., LONG. 70° 04′ E.

July 14th. Indian Ocean. Sea moderate, slightly choppy with a long swell. 11.30 a.m. Two shearwaters off the starboard side.

12 NOON: SHIP'S POSITION LAT. 7° 18′ N., LONG. 64° 37′ E.

Between 1.45 and 2.00 p.m. two more shearwaters were seen, one flying within 200 yards of the ship. It then moved further out and was joined by several more which gradually dropped astern; one was seen to settle for about a minute. The one that came close was almost certainly a Wedge-tailed Shearwater; at 6.15 p.m. another one was seen.

July 15th. Indian Ocean. Sea moderate, with increased wind and swell. 7.28 a.m. A single shearwater (Wedge-tailed) on starboard bow. 9.10 a.m. another single shearwater.

12 NOON: SHIP'S POSITION LAT. 7° 17′ N., LONG. 59° 28′ E. Afternoon; sea subsiding slightly. No birds seen.

July 16th. Indian Ocean. Sea moderately rough, wind W.S.W. No birds seen.

12 NOON: SHIP'S POSITION LAT. 7° 30′ N., LONG. 54° 48′ E.

July 17th. Indian Ocean. Strong westerly wind; sea moderately rough.

6.30 a.m. Three Dusky Shearwaters (*Puffinus assimilis*) flying low to starboard, one settled on water for a few seconds. 7.35 a.m. Two more Dusky Shearwaters flying at a short distance from the ship; they fly like Wedge-tailed Shearwaters but with more flapping and more wheeling, showing first the dark brown of the upper plumage and then the white of the lower. 8.43 a.m.: Another Dusky Shearwater. Ship is now about 90 miles east of the African coast. 10.20 a.m.: Flock of 8 to 12 Dusky Shearwaters, wheeling and flapping occasionally; one settled on the water for a few seconds. One larger, dark shearwater, further away appeared to be a Wedge-tailed Shearwater. 11.15 a.m.: A single shearwater (Wedge-tailed) crossed our bows flying west.

11.30 to 11.50 a.m. Several Dusky Shearwaters seen, two couples and a single bird, all flying west.

12 NOON: SHIP'S POSITION LAT. 9° 59′ N., LONG. 52° 12′ E. 1.00 p.m. Single Dusky Shearwater. 3.00 p.m.: We are now passing Ras Hafum at about 6 miles distance.

3.30 p.m. Many Dusky Shearwaters, flying in various directions. 3 Red-billed Tropic-birds (*Phaëthon aethereus*), distinguished by their red beaks, black-barred upper plumage and long white tails passed the ship; one flew high near by and the other two kept more or less together. Dusky Shearwaters numerous, flying singly or in small open-order flocks. 4.30 p.m.: Two or three single Dusky Shearwaters, wheeling at a little distance from the ship. No more birds seen. At about 9.30 p.m. we turned into the Gulf of Aden, passing Cape Guardafui light.

July 18th. Gulf of Aden. About 40 to 50 miles off N. coast of Somaliland. Wind slight; slight swell. 5.30 a.m.: Wilson's Storm Petrels have reappeared; passed about 12 flying low over the water, close to the ship, also two Red-billed Tropic-birds. Between 7 and 7.30 a.m. we passed into calm waters; Wilson's Storm-Petrels very numerous indeed; many settled on the water, others flying close above; several hundreds could be seen on both sides of the ship. It would appear that these petrels had collected in this more or less calm area for good feeding and were then resting. 7.30 a.m.: One Wedge-tailed Shearwater and very many Wilson's Storm-Petrels. One Aden Sooty Gull (*Larus hemprichi*) accompanied the ship for about 10 minutes hanging above our stern; it then settled on the water and drifted astern. 7.45 a.m. passed two Wedge-tailed Shearwaters flying and one Blue-faced Boody (*Sula dactylatra*) on the water.

7.50 a.m. Three Brown-winged Terns (*Sterna anaetheta*) flew past flying east low over the water, together with several Wedge-tailed Shearwaters. Between 8.30 and 8.45 a.m.: One Wilson's Storm Petrel and two Brown-winged Terns were passing and two Aden Sooty Gulls were following the ship. 9.00 a.m.: Several Wedge-tailed Shearwaters were seen at little distance away and one Wilson's Storm Petrel, but bird life is now scarce again. 10.38 a.m.: 2 large terns, blackish upper plumage, white lower—similar to (but considerably darker than) Brown-winged Terns, passed the ship; they appear to be Sooty Terns (*Sterna fuscata*). No other birds seen before noon.

12 NOON: SHIP'S POSITION LAT. 12° 04′ N., LONG. 48° 12′ E. 1.10 p.m.: Two shearwaters appeared, they are slightly lighter chocolate brown in colour and slightly larger in size than Wedge-tailed Shearwaters; they may have been Pale-footed Shearwaters (*Puffinus carneipes*). One Wilson's Storm-Petrel was also passed, 3.30 to 4.45 p.m. Large numbers of Sooty Tern (*Sterna fuscata*) flying low over the water, came up from far out to the east and crossed our bows in a steady stream of small flocks flying in open order. Many hundreds must have passed us, all flying in the same direction i.e. south-west towards the Somaliland coast. I have never before seen such a remarkable flight of birds at sea. Several Wilson's Storm Petrels were also passed but they were not flying with the terns. There was, however, an occasional Brown-winged Tern (smaller and browner) flying with the Sooty Terns. The flight of Sooty Terns continued until after 5.00 p.m., gradually tailing off. An occasional flock of 7 or 8 Sooty Terns mostly flying in couples, continued to pass until about

5.45 p.m., but none was seen after that time. A few Wilson's Storm Petrels were seen up to about 6.00 p.m. when the light became too poor to see.

July 19th. Gulf of Aden to Red Sea. Sea smooth; 5.15 to 5.30 a.m.: Very large numbers of Wilson's Storm Petrels, many settled on the water, gradually became fewer until the last was seen about 6.00 a.m. Many of these petrels appeared to be in moult with ragged plumage. 6.10 a.m.: Three Aden Gulls were overtaken flying in the same direction in which we were heading; after remaining with us for 10 minutes or so they dropped astern.

6.25 a.m. to 8.00 a.m.: A large falcon joined the ship and 4 Brown Boobies (*Sula leucogastra*) were passed, one of which was sitting on the water. Just before passing through the Straits of Babel Mandib, a large flock of terns with grey mantles, black caps and orange-red beaks was passed, many of them were diving down after small fish; they appeared to be the lesser Crested Sea-Tern (*Sterna bengalensis*) but I could not be sure of their identification. Several Wilson's Storm Petrels were also passed.

At 8.00 a.m. we sighted land to starboard and commenced to pass through the Straits of Babel Mandib and into the Red Sea.

M. V. 'WORCESTERSHIRE': *Outward Voyage: January 13th to 20th* 1950.

January 13th 1950. *Gulf of Aden. Approaching Aden Harbour.* Sea calm but considerable ripple; sky overcast and cloudy; land visible 10 to 12 miles to port.

6.10 a.m. *to* 7.30 a.m.: No petrels; Lesser Black-backed Gulls (*Larus fuscus*), Herring Gulls (*Larus argentatus*) and Aden Sooty Gulls (*Larus hemprichi*) met us in increasing numbers as we approached Aden Harbour. In harbour, several Large Crested Sea Terns (*Sterna bergii*) were noted, together with many Aden Gulls and Black-headed Gulls (*Larus ridibundus*) and lesser numbers of Herring Gulls and Lesser Black-backed Gulls. 4.30 p.m. to dark: Leaving Aden Harbour only the four species of gulls, seen in the harbour, were noted together with a few Large Crested Sea Terns.

January 14th 1950. *Gulf of Aden.* Sea smooth with a slight swell and ripple; weather clear and cool. 6.30 to 6.45: No birds. 6.45 a.m.: A small dark shearwater crossed our bows flying rapidly with rather quick wing beats but the light was not good enough for identification. Then 4 small shearwaters, dark brown above and whitish below, flew close over the water nearby. One settled and the others continued flying quickly and gliding occasionally, rather faster than the ship and disappeared ahead; they appeared to be Dusky Shearwaters. 7.20 a.m. Two Tropic-birds passed over and circled near the ship, they had red beaks, white wings with black wing-tips, long white tail feathers—probably the Red-billed Tropic-bird. 8.10 a.m.: Two very small birds, with whitish underparts, flying close above the sea appeared to be phalaropes—probably *P. lobatus*. At 11.15 a.m. two more phalaropes flying a little distance away on the same course as the ship. Just before midday two medium sized shearwaters, dusky chocolate brown above and a little lighter on the under plumage, with rather longish wedge-shaped tails, passed—probably Wedge-tailed Shearwaters.

12 NOON: SHIP'S POSITION LAT. 12° 14′ N., LONG. 48° 04′ E. 12.30 to 4.00 p.m.: Four Wedge-tailed Shearwaters flying singly were passed and a single gull, which appeared to be immature Herring Gull, followed in our wake. 4.30 to 4.45 p.m.: Several parties of phalaropes, flying rapidly close over the water in different directions were passed. One party was seen to settle on the water. At 5.18 p.m. when we were about 8½ miles from Ras al Fil or Ras Filuk on the Somaliland coast, two dark brown skuas, of medium size, were observed flying together and chasing one another. One of them came closer and flew in our wake for a few minutes together with the immature Herring Gull, it appeared to be a Pomatorhine Skua (*Stercorarius pomarinus*) but identification was not certain as it was too far away.

January 15th 1950. *Gulf of Aden.* Sea calm with a slight ripple and swell; weather bright and clear.

6.15 a.m. Two dark chocolate-brown, medium sized shearwaters (probably *Puffinus pacificus*), crossed our bows in the direction of Socotra and the Brothers Islands, which were just visible about 15 miles away, northwards. One Tropic-bird (*P. lepturus*) passed flying some 50 feet above the sea. 9.15 a.m.: A single Brown Booby (*Sula leucogastra* probably) flew past, flying westwards about 50 to 60 feet above the sea.

12 NOON: SHIP'S POSITION LAT. 11° 29′ N., LONG. 54° 42′ E. No more birds seen.

January 16th 1950. *Indian Ocean.* Sea smooth with slight ripple; weather clear and sunny.

7.15 a.m. Three tropic-birds appeared, flying more or less together. Some black on the back and mantle but tails rather short. One settled on water and dived several times. 9.20 a.m.: Another tropic-bird appeared and flew round and over the ship for over 10 minutes. Beak yellow, black line below eye, wing tips black, some brown on the mantle and short tail—apparently an immature bird. It flew mostly about 50 feet up and was seen to dive into the sea, several times. It disappeared completely beneath the surface when it dived. No birds of any other species seen.

12 NOON: SHIP'S POSITION LAT. 10° 30′ N., LONG. 60° 01′ E. No birds seen during the afternoon but at 5.45 p.m. a single tropic-bird appeared flying high round and above the ship for over 5 minutes. Several times it passed quite close. It had a short tail, yellow beak, black tips to the primaries and much brown on the upper plumage; it appeared to be a White-tailed Tropic-bird (*Phaëthon lepturus*). No other birds seen.

January 17th 1950. *Indian Ocean.* Sea smooth with slight ripple and swell; weather bright and clear. No birds.

12 NOON: SHIP'S POSITION LAT. 9° 33′ N., LONG. 65° 24′ E.: Afternoon and evening no birds seen.

January 18th 1950. *Indian Ocean.* Sea smooth, with slight ripple and swell; weather clear and bright.

9.23 a.m. A tropic-bird passed flying and circling high over the sea; long white tail with a little black on the upper plumage—a Red-billed Tropic-bird. No other birds seen during the morning.

12 NOON: SHIP'S POSITION LAT. 8° 48′ N., LONG. 70° 39′ E.: About 4.30 p.m.: Two unidentified birds reported. No other birds seen. Passed Minicoy Island Light about 11 p.m.

January 19th 1950. *Indian Ocean.* Sea smooth, with very slight ripple and swell; clear and sunny. No birds.

12 NOON: SHIP'S POSITION LAT. 7° 38′ N., LONG. 76° 03′ E.: No birds seen this day.

January 20th 1950. Arrived Colombo Harbour soon after dawn. Many Terns and Brown-headed Gulls in Harbour.

REFERENCES

Bryson, A. G. S. (1949): Wilson's Storm-Petrel (*Oceanites oceanicus*) in the Gulf of Aden. *Jour., Bom. Nat. Hist. Soc.,* **48** (2): 362.

Gibson-Hill, C. A. (1950): Tropic-birds occurring in the Indian Ocean and adjacent Seas. ibid, **49** (1): 66.

TURTLE FISHING IN THE SEA AROUND KRUSADAI ISLAND

BY

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Gulf of Mannar

(*With a text figure*)

Turtle fishing has been practised for ages on the south-eastern shores of the Indian Peninsula, particularly around Krusadai Island, where it has long been conducted by non-Hindu fishermen. Hindu fishermen do not generally fish for turtles; their indifference being attributed to their religious belief that the second of the *dasavatars* had the form of a turtle[1].

If properly organised and developed, the fishery can be made economically very beneficial. At present between 800 to 1,000 turtles are annually landed in Krusadai area itself, where the fishery goes on throughout the year.

Four species of turtles have been identified in the commercial catches. They are:

1. The Green Turtle, *Chelonia mydas* Linne,
2. The Hawksbill Turtle, *Eretmochelys imbricata* Linne,
3. The Olive Logger-head Turtle, *Caretta caretta olivacea* Eschscholtz,
4. The Brown Logger-head Turtle, *Caretta caretta gigas* Deraniyagala.

METHODS OF CAPTURE. Turtles are caught by special types of wall nets. These nets are made of the fibres of *Acacia planifrons* W. & A., or of cotton yarn[2].

Stems of acacia are cut into pieces of convenient size. The bark is peeled off and soaked in water to render easy the extraction of fibres. The extraction is done by stripping of the outer greenish layer of the bark with the finger nails. The fibres are then spun into the required thickness, which varies from ½ to ¾ inch. Yarn nets, being more costly were scarcely used during the war years.

There are two important types of nets in use. These are known as 'Pachu valai' and 'Kattu valai' in Tamil and have the same general structure, but differ in the method of their employment. Both nets require between 5 to 8 men each for operation.

Pachu valai (text fig.): This net is rectangular, 70 ft. long and 9 ft. high, with a 2 inch-square mesh. The upper edge has a hauling rope (head rope) extending beyond the length of the net. There is a corresponding foot rope at the lower edge of the net. The extensions of the head and the foot ropes are tied together at each extremity. At one end a long rope with an anchoring weight (stone) is attached and at the other another rope with a conspicuous buoy.

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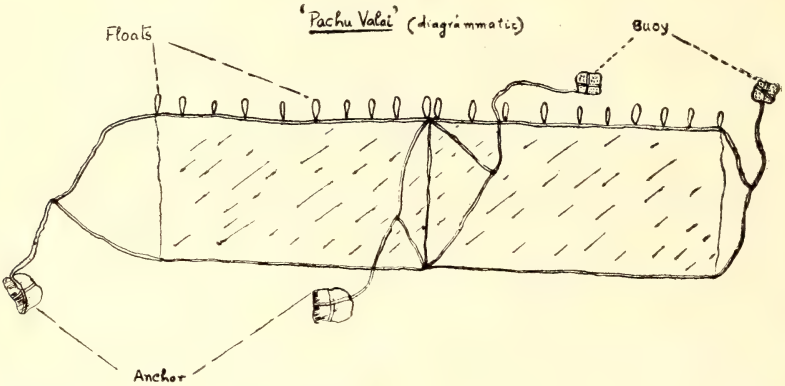
[1] But see footnote 5 on p. 529 re tortoise flesh being permissible to Brahmins.—EDS.

[2] The fibres from the bark of *Calotropis* are also used in making nets. From the reports that could be gathered at Pamban, I understand that these nets are more popular in the Tuticorin area.



'Pachu valai' joined together for operation. The relative positions of the anchor, buoy and floats are indicated.

The head rope is also provided with 10 wooden floats of small size about 7 ft. apart.

The net is usually cast or set at night at the entrance of two parallel coral reefs and is hauled in after the lapse of 12 to 18 hours. The anchoring weight holds the net in position, while the rope with the buoy helps location of the net and its removal. The upper edge of the net lies on the surface of the water on account of the floats, its own weight enabling it to stay like a porous and flexible wall in the water. The struggle of a turtle entangled in the meshes causes the lower end of the net to roll up and to envelop it completely.

If the gap between the reefs is sufficiently wide, two such nets (each with anchor, buoy and floats) are used. The nearer ends of these nets are joined by a flimsy cord, which may easily be snapped, when a turtle is entangled.

A solitary turtle per net is the usual haul. Occasionally, with luck, 2 or 3 turtles are caught in a single net. But there are occasions when there is no catch at all. Catches are larger on darker nights and about the time of the new-moon.

Kattu valai: This net is longer and is devoid of the anchor and buoy. Fishing with this net is also conducted between two coral reefs, but in a much shallower area. Six fishermen usually operate the net. Four of them get into the water and the remaining two wait in a canoe. Two of those in the water stretch the net taut, while those in the canoe beat the surface of the water or the sides of their vessel to drive turtles into the net. The remaining two in the water haul the catch ashore. If more people are available the operation will be easier and more effective. The net is usually laid on full-moon nights. The fishing is generally conducted for two hours, but catches are not encouraging.

Pachu valai is more popular among the fishermen in the Kursadai area.

FOOD AND BIONOMICS: The Green Turtle is a vegetable feeder, subsisting on marine algae such as *Gracillaria, Sargassum,* and the marine phanerogam *Cymodocea. Gracillaria* seems to be its favourite diet.

Deraniyagala (1939)[1] remarked that this species is omnivorous but essentially vegetarian, and feeds upon *Cymodocea* and *Thalassia* also *Zostera, Halophila* and other algae. Parts of the sea with luxuriant submerged vegetation are usually favourable grounds for the fishery.

The Hawksbill Turtle is carnivorous and the Olive Logger-head Turtle is reported to have cannibalistic tendencies, especially when young. (Deraniyagala, 1939).

Both the carapace and the plastron of most of the Green Turtles examined in the laboratory of Krusadai Biological Station were found to be infested with Turtle Barnacle, *Chelonobia testudinaria* Linne.

Deraniyagala (1939) has described the breeding habits of turtles in Ceylon. Chacko (1942)[2] has indicated the changes in the details of the nesting habits of the Olive Logger-head Turtle in Krusadai Island. Two nests of this turtle were observed in October 1949 on Shingle Island above the high-tide mark. The number of eggs in each were 40 and 50. The numbers are very much below those recorded by Deraniyagala (1939) and Chacko (1942). Though the mother turtle 'tries to hide all traces of the packing of her eggs' as observed by Chacko (1942), the egg nests could be detected by the loose nature of the soil in the covered burrow. The thrust of a stick into the sand enabled detection of the looseness of the packed soil and thus helped the location of the nest. This method is also adopted by the turtle nest hunters in Krusadai area.

ECONOMIC IMPORTANCE OF TURTLE FISHING: The majority of the turtles landed in the Krusadai area are Green Turtles known as *'Peramai'* (Tamil). They are edible. The other turtles are seldom eaten.

The catches of the Green Turtle are graded for sale according to the maximum width of the plastron into three or four sets as follows:

Set	Width of Plastron	Prices in Rupees	
		Pre-war	Post-war
1.	Over 26″	12	25
2.	Between 21″ — 26″	6	15
3.	Between 16″ — 21″	4	12
4.	Under 16″	4	6

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[1] Deraniyagala, P.E.P. (1939) Tetrapod Reptiles of Ceylon. Vol. 1.

[2] Chacko, P. I. (1942). *Cur. Sci.* **12** (2): 60.

The price of turtles has risen after the war, but fishing and the catches remain at pre-war level.

The edible variety is exported mainly to Ceylon, where a lucrative market exists for it. The absence of any excise duty for exporting live turtles is a great encouragement to the trade. Live turtle wells are maintained at Pamban to ensure a regular supply for the trade.

Inedible turtles are not entirely useless, their shells providing the bases of a minor cottage industry for the manufacture of crude ornaments.

Oil from turtles is extracted by melting the fat in pans and sieving it through coarse cloth. The extracted oil is used to smear country crafts (Chacko 1942) and to make crude medicinal preparations. The oil of the Green Turtle is sometimes used as a substitute for ghee. The cost of oil at Pamban varies between 5 to 7 annas a pint.

Transport of live turtles by rail and boat is easy if they are kept upside down. This position renders them practically immobile. They are hardy and are known to have thriven well outside their native element for well over a month.

ACKNOWLEDGMENTS

This article is published with the kind permission of the Director of Fisheries, Madras, to whom my grateful thanks are due. I am also grateful to Dr. Beni Charan Mahendra and Sri K. Chidambaram for their valuable suggestions and constructive criticism.

MORE NOTES ON THE BIRDS OF THE NEPAL VALLEY

BY

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The following notes are intended as a supplement to Mrs. Proud's interesting article on 'Some Notes on the Birds of the Nepal Valley', published in the *Journal* for December 1949 [1]. They are abstracted from notes made during the following periods of war leave spent with my parents in Kathmandu (my father being at the time Forest Adviser to the Government of Nepal):—

1942 31st May—20th September
1943 24th October—16th November
1944 10th June—1st July
1945 29th November—28th December

Apart from a trip in the first 15 days of September 1942 along the pilgrim trail to Gosainkund and beyond, my notes on which have already appeared in the *Journal* [2] these periods were spent in Kathmandu itself with a few visits for a night or two up to the bungalows at Kakini and Nagarkot. I made a point of climbing to the summit of Phul Chok, Sheopuri, and the highest peak on the Chandragiri range at least once each year, and in 1942 Phul Chok was climbed a number of times. After the end of June the rain or mist and leeches make observation difficult. Those were memorable mountain days, and the right antidote to warfare in the Burma jungles. My only regret is that I did no collecting, under the mistaken impression that Hodgson's prodigious collections of a hundred-odd years before had made further work in this field superfluous.

Urocissa flavirostris: Yellow-billed Blue Magpie.
Noted on Phul Chok at 8,000 ft.

Suthora nipalensis: Nepal Suthora.
Noted on Phul Chok at 8,500 ft.

Sitta frontalis: Velvet-fronted Nuthatch.
Noted in the Valley and on Nagar Jong.

Garrulax leucolophus: White-crested Laughing-Thrush.
Occurs on Nagar Jong at 5,000—6,000 ft.

Garrulax striata: Striated Laughing-Thrush.
Noted once on Phul Chok at 6,000 ft.

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[1] Vol. 48 (4), pp. 695–719.
[2] Vol. 47 (3), pp. 432–443.

Trochalopteron erythrocephalum: Red-headed Laughing-Thrush.

This is not confined to Sheopuri being also not uncommon on Phul Chok and the Chandragiri range, at 6,000—9,000 ft.

Trochalopteron lineatum: Streaked Laughing-Thrush.

Seen at 6,200 ft. near the top of the Sisagarhi pass on the road to Kathmandu, but never in the Nepal Valley.

Pomatorhinus schisticeps: Slaty-headed Scimitar Babbler.

Noted on Sheopuri, doubtfully elsewhere.

[**Acanthoptila nipalensis**: Spiny Babbler.

Mrs. Proud's record of this rare species from the Nepal Valley is of considerable interest; I never had the good fortune to see it.]

Pellorneum ruficeps: Spotted Babbler.

Noted on Nagar Jong at 5,000 ft.

Stachyris nigriceps: Black-throated Babbler.

Noted at 5,000 ft. on Phul Chok and the Chandragiri range.

Stachyridopsis ruficeps: Red-headed Babbler.

Noted on October 27th on Sheopuri; doubtfully seen on Phul Chok.

Pseudominla castaneiceps: Chestnut-headed Tit-Babbler.

Like Mrs. Proud, I have only seen this species on the Chandragiri range; a large party was encountered at 8,000 ft. on November 5th.

Fulvetta vinipecta: Fulvetta.

Probably a resident species on Phul Chok and Chandragiri range above 8,000 ft.; in small flocks in the undergrowth.

Actinodura nipalensis: Hoary Barwing.

Another resident species above 8,000 ft. on Phul Chok and Sheopuri. Usually on mossy tree-trunks.

Siva cyanouroptera: Blue-winged Siva.

Another resident species above 8,000 ft. on Phul Chok and Sheopuri.

Ixulus flavicollis: Yellow-collared Ixulus.

Noted on Chandragiri as well as on Sheopuri.

Leiothrix lutea: Red-billed Leiothrix.

In 1942 this species was not seen in June, July, or August, but a solitary bird was seen at 7,000 ft. on September 1st on Sheopuri.

Pteruthius erythropterus: Red-winged Shrike-Babbler.

Noted on Phul Chok and Sheopuri as well as on Nagar Jong, mostly at or near 7,000 ft.

Certhia sp. Treecreeper.

The identity of the species found in this area needs clearing up ; I have seen Treecreepers at 7,000—8,000 ft. on Sheopuri, which I recorded as *discolor.*

Tesia castaneocoronata : Chestnut-headed Wren.

Probably resident on Phul Chok above 8,000 ft.

[**Larvivora brunnea :** Indian Blue Chat.

On Phul Chok at 8,500 ft. in June I saw what I believe was a male of this species skulking in the undergrowth but I did not get a good enough view to be certain of identity. Blue upper parts, white eyebrow, and chestnut under parts were noted.]

Tarsiger chrysaeus: Golden Bush Robin.

In the last week of October 1943 I observed this species on Phul Chok and Sheopuri.

Saxicola caprata : Pied Stonechat.

Noted only on Sheopuri.

Rhodophila ferrea : Dark Grey Bush Chat.

Seen once on the summit of Phul Chok, date not recorded.

Oreocincla dauma (or **mollissima**) : Mountain Thrush.

Seen only on the summit of Sheopuri.

Cochoa purpuera : Purple Thrush.

One record of this rare species on the Sheopuri ridge at 7,000 ft.

Siphia strophiata : Orange-gorgeted Flycatcher.

Seen only above 8,000 ft., on Phul Chok and Sheopuri, where a few pairs are probably summer residents.

Culicicapa ceylonensis : Grey-headed Flycatcher.

Noted on Phul Chok and Chandragiri.

Niltava grandis : Large Niltava.

Noted on Phul Chok at 7,000 ft., where it is probably resident.

Niltava sundara : Rufous-bellied Niltava.

Like Mrs. Proud, I have noted this only on the Chandragiri range, at 8,000 ft.

Chelidorhynx hypoxanthum : Yellow-bellied Flycatcher.

A few pairs are summer residents on Phul Chok and Sheopuri above 8,000 ft.

Rhipidura albicollis : White-throated Fantail Flycatcher.

Noted only on Sheopuri in the Nepal Valley, but also on the Sisagarhi pass.

Hemipus picatus: Pied Shrike.

Like Mrs. Proud, I have seen this only on Nagar Jong.

Seicercus burkii: Black-browed Flycatcher-Warbler.

Noted only on Phul Chok above 8,000 ft., where a few pairs are probably summer residents.

Seicercus castaneoceps: Chestnut-headed Flycatcher-Warbler.

One record from the Chandragiri range, November 5th.

Abroscopus schisticeps: Black-faced Flycatcher-Warbler.

Noted on the Chandragiri range.

[**Suya criniger**: Brown Hill Warbler.

I have a note of this on Sheopuri, but Mrs. Proud does not record it and it is just possible I confused it with *Acanthoptila*,[1] so I leave it as doubtful.]

Pyrrhula nipalensis: Brown Bullfinch.

One record at 7,000 ft. on Sheopuri (above Sundarijal); September 15th.

Riparia concolor: Dusky Crag Martin.

Seen at Kakini bungalow on November 3rd.

Martula nepalensis: Hodgson's House Martin.

Seen round the highest point of the Chandragiri range on November 5th.

Aethopyga nipalensis: Nepal Yellow-backed Sundbird.

Noted on the Chandragiri pass, October 24th.

Picus chlorolophus: Small Yellow-naped Woodpecker.

Noted only on Nagar Jong.

Blythipicus pyrrhotis: Red-eared Bay Woodpecker.

Noted on Phul Chok at 5,000—6,000 ft.

Hierococcyx sparveroides: Large Hawk-Cuckoo.

Heard on Phul Chok and Sheopuri.

Hierococcyx fugax: Hodgson's Hawk-Cuckoo.

Noted on the Chandragiri range.

Cacomantis merulinus: Plaintive Cuckoo.

Heard on Sheopuri.

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[1] Or vice versa ?—EDS.

Surniculus lugubris : Drongo Cuckoo.

Heard on Sheopuri.

Merops leschenaulti : Chestnut-headed Bee-eater.

Noted in the Valley, date not recorded.

Chaetura caudacuta : White-throated Spinetailed Swift.

Seen flying over Sheopuri.

Caprimulgus indicus : Jungle Nightjar.

Heard at the bungalow below the Sisagarhi pass. A nightjar seen on the branch of a tree at the foot of Nagar Jong may have been this or *macrourus*.

Otus bakkamoena : Collared Scops Owl.

Heard calling in the Valley, June 14th.

Glaucidium cuculoides : Barred Owlet.

Also heard calling in the Valley, date not recorded.

Glaucidium brodiei : Pigmy Owlet.

Heard calling on Phul Chok at 6,000 ft. Seen Chandragiri range.

Gyps indicus : Long-billed Vulture.

Noted in the Valley.

Neophron percnopterus : White Scavenger Vulture.

Noted in the Valley.

Aquila chrysaetos : Golden Eagle.

One afternoon near the foot of Nagar Jong we spent half an hour with glasses at fairly close range watching one of these magnificent birds plucking a Blue Rock Pigeon. The eagle was 30 ft. up a pine tree, and did not seem to be at all shy. December 5th.

Treron curvirostra : Thick-billed Green Pigeon.

Noted on Phul Chok and Nagar Jong.

Columba livia : Blue Rock Pigeon.

Though not mentioned by Mrs. Proud (perhaps because not considered to be truly feral) this is a very common bird of the Valley and is often shot for sport.

Gallus gallus : Red Junglefowl.

Seen only on Nagar Jong.

Gennaeus leucomelanus : White-crested Kalij Pheasant.

Seen on Phul Chok and Nagar Jong at 6,000 ft.

Arborophila torqueola : Common Hill Partridge.

Noted on Phul Chok at 6,000 ft.

Francolinus francolinus : Black Partridge.

Noted on Sheopuri.

Ardea purpurea : Purple Heron.

Noted in the Valley.

Ducks. In the gardens of the palace belonging to General Sir Kaiser Shumshere there is a duck pond where the migratory duck are allowed to settle and remain undisturbed so that they become very tame and are easily observed. Hundreds of duck frequent the pond in winter and the General himself takes a keen interest in observing them. I remember him pointing out a female Gadwall on one occasion.

OBSERVATIONS ON THE BIONOMICS AND FISHERY OF THE BROWN MUSSEL (*MYTILUS* SP.) OF THE CAPE REGION OF PENINSULAR INDIA[1]

BY

S. JONES

(*With a text map and two plates*)

(Communicated by Dr. S. L. Hora)

INTRODUCTION

Brown Mussel fishing is a regular industry of considerable local importance along the rocky coastal tracts of Southern Travancore and the Tinnevelly District of Madras Province. From Kovalam near Trivandrum up to Cape Comorin, the 'Land's End' of India, along the west coast, and beyond as far as the Tinnevelly District on the east coast, the sea shore consists of frequent stretches of rock with intermittent beaches of sand. Several fishing villages nestle along these beaches and some as at Vizhinjam, Pulluvila, Poovar, Thengapatnam, Midalam, Kolachal, Muttam, Manakudi, Cape Comorin and Leepuram are very large ones, each consisting of hundreds of families carrying on inshore, foreshore and to some extent offshore fishing with country boats and catamarans. The fairly close proximity of the Wadge Bank to this area gives a rich yield of fish to the enterprising fishermen and in comparison to this, the value of the Brown Mussel fished is not great. Despite this, Brown Mussel fishery plays an important part in the economy and dietary of quite a large number of people along the coast since, in addition to giving employment with a modest income to several hundreds of people for about 6 to 8 months in the year, thousands are benefited by the availability of a very nutritious and palatable article of diet as an alternative to ordinary fish especially during the months when the latter is scarce.

Brown Mussel is known as 'chippi', 'muthuva' or 'muthuvachippi' in Malayalam[2] and as 'kallika' and 'kadalka' in Tamil. It is no exaggeration to say that it is a food of the greatest delicacy to those accustomed to it and it is even said that some develop almost a sort of craving if unable to get it for a long time. About a quarter of a century ago this was popular only amongst the poorer and backward classes whereas now it is liked by all the fish-eating people including many among the high-castes so much so that during the season when the mussel is in prime condition there is practically a scramble for it as soon as it is brought to the shore. Some of the poor people when they go on a visit to their relatives living in the interior of the country take a quantity of mussel and bring back in return with them cassava or tapioca (*Manihot utilissima*) roots.

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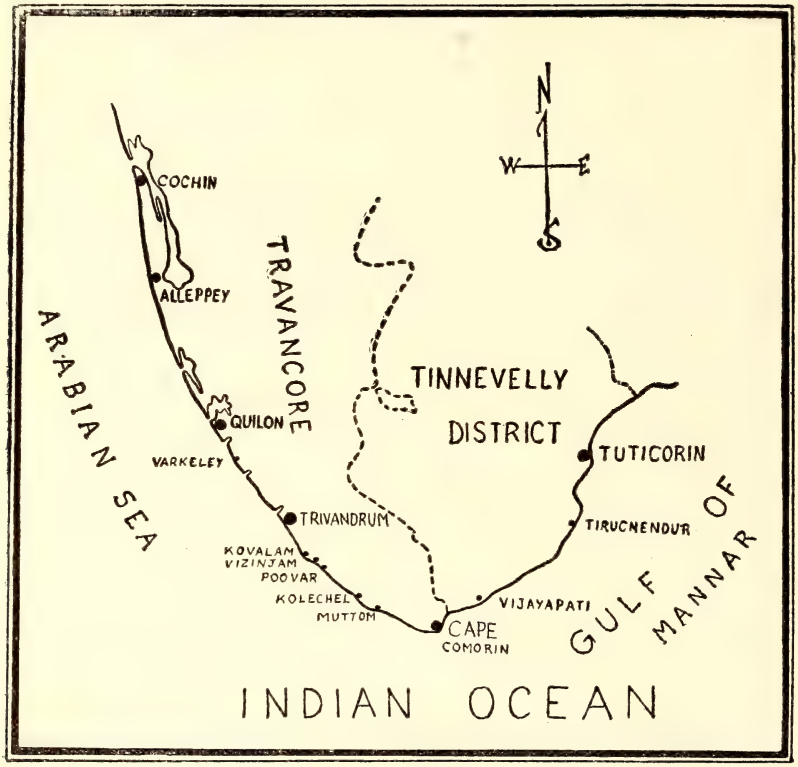
[1] Observations mainly relate to the conditions on the West Coast. The article was prepared in 1947 and finalised after the author joined the Central Inland Fisheries Research Station, Barrackpore.

[2] In Malabar the Green Mussel is known as 'Kallumalkai' and the small sized young stages are known as 'Kadukka'.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MUTTOM
CAPE
COMORIN
VIJAYAPATI
TIRUCHENDUR
TUTICORIN
TINNEVELLY
DISTRICT
GULF OF MANNAR
INDIAN OCEAN

The Cape region of peninsular India, showing the important Brown Mussel fishing centres in South Travancore.

Distribution and Systematics

Regarding the distribution of the Brown Mussel, so far as the writer knows, it is confined to the South Travancore and Tinnevelly coasts. The Green Mussel is only occasionally seen in South Travancore but its abundance increases from the Cape towards the Tinnevelly side. Both the Brown and Green Mussels have been collected from Varkaley between Trivandrum and Quilon. Only the latter species was collected by the writer from the piles of the pier at Alleppey Port in North Travancore, and the Madras Harbour, and Pamban near Rameswaram and also from the Colombo Harbour. Reasons for the restricted distribution of the Brown Mussel are not known.

Our present knowledge about the biology and fishery of the Brown Mussel is mainly confined to the brief remarks of Hornell (1917 & 1921) in his accounts of the 'Edible Molluscs of the Madras Presidency' and the 'Common Molluscs of South India' respectively. Rao (1941), presumably basing his observations on Hornell's account, refers to the fishery of Brown Mussel in general terms.

Dealing with the Green and Brown Mussels Hornell[1] (1947) says as follows:—'One of these is the very handsome Green Mussel (*Mytilus smaragdinus* Chem.) readily recognised because of the handsome green coloration of the horny membrane of periostracum investing the surface of its valve; the other is an even larger species, less elegant in contour, coated with a coarse brown periostracum that looks commonplace when contrasted with the vivid tint of the green. The former species is distributed widely upon the Madras coast extending as it does almost continuously from South Kanara on the west coast to the borders of Orissa on the east. The brown form, on the other hand, is confined so far as I am aware to the extreme south of Travancore and of the Tinnevelly District'.

'This mussel', he writes, 'is the largest and the stoutest species found in South India attaining commonly a length of 4 inches. It is distinctly larger than the Green Mussel, but unlike the latter its distribution is limited to a comparatively short length of coast in South Travancore, where it displaces the green species. The coast there is exposed to exceptionally heavy seas during the monsoons but in spite of this it thrives in great abundance on rocks from low tide to a depth of about 2½ to 3 fathoms. Annually large quantities are taken from the rocks by divers. They form an important food item among fishermen and coast Muhammadans'.

It is unfortunate that there is no information about the quantity fished from the coasts of Tinnevelly and South Travancore though thousands of maunds (gross weight) are collected every year. In the latest fish marketing survey report[2] there is also no record of the collections.

BIONOMICS

The Brown Mussel thrives well on firm, clean substratum, to which the anchoring threads or byssus are firmly attached. The surface of the rock should be devoid of algal growth or sand for the spat to take hold and develop into mussel. Complete submergence and clear water, with as little suspended impurities as possible but with plenty of food and light, are ideal conditions for its proper growth. It is known to thrive up to a depth of about 20 feet. Specimens subjected to waves carrying sand get easily choked by the latter and perish.

The breeding season of the mussel appears to be extended, but the main peak period is from June to August (Plate I, 2.) during the monsoon months when the sea is rough and advances considerably on to the shore. The rocks in the littoral region, which in summer were exposed, get covered by the sea which is so rough that a natural close season is established. Clusters of the mussel appear in almost all the clean submerged portions of the rocks. There is a secondary spurt of breeding during October and November, but the intensity of which could in no way be compared to that of the first season. The mussels from the June-August spats do not become sexually mature by October-November to bring about the second spat formation.

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[1] In Hornell's recent 'The Study of Indian Molluscs' (*J. Bombay Nat. Hist. Soc.*, **48** (3), 1949. p. 562) he gives the same information except that he calls the Green Mussel, *Mytilus viridis* L. It is rather strange that the specific name still remains unknown.

[2] 'Report on the Marketing of Fish in India.' Delhi. 1946.

THE FISHERY OF THE BROWN MUSSEL

The fishing season commences in September after the southwest monsoon when the sea becomes calmer and water begins to recede. The rocks in the littoral region that were covered by the seas gradually get exposed showing a dark brown carpet of young *Mytilus* (Plate III, 1.). The receding sea continues to send frequently waves which sweep over its former domain and help to keep the mussels alive. The fishing is at first confined to the rock pools (Plate II, 2.) and little baylets from where the fishermen collect the mussel cautiously retreating to the safer and higher ground whenever high waves sweep over the place. The less venturesome old men, children and some women make collections from the semi-exposed beds. Mussels from such situations being mostly half-starved are in little demand by the public and are usually taken by the collectors for their home consumption. As weeks go on, the sea recedes considerably and the men enter the sea for regular collection (Plate I, 3.). The regular fishing season is from mid-November to April-May. From December onwards large specimens of mussel known as *muthuva* or *muthuvachippi*[1] (Plate I, 1.) which are the survivors of the previous year's brood, become available and the crop increases both in quality and quantity by January and February. This is usually in such prime condition that the demand is very high. It has been found that for some inexplicable reasons the mussel sometimes grow 'lean' and lose their 'condition' (Plate I, 1.).

It appears that the condition of the gonads is mainly responsible for the fat and lean condition of the mussel, and as Kesteven (1941) says in the case of oysters this 'may be determined by a complex interaction of biological rhythms and water conditions'. This is a matter that requires elucidation in the case of our mussels. Some say that the phenomenon locally known as 'kara' (which means 'milk' or 'sap') in the sea is responsible for this, while some others say that after the 'kara' the mussel gets into good condition. Whatever be the cause the mussel is in good condition between two 'karas'! It is said that when this phenomenon happens water loses its clear transparency and turns somewhat turbid and the men do not generally enter the sea at this time since it would irritate the eyes. The sea water examined by the writer three days after a case of 'kara' was reported showed a large quantity of *Noctiluca* in it. 'Kara' usually occurs from February to April[2].

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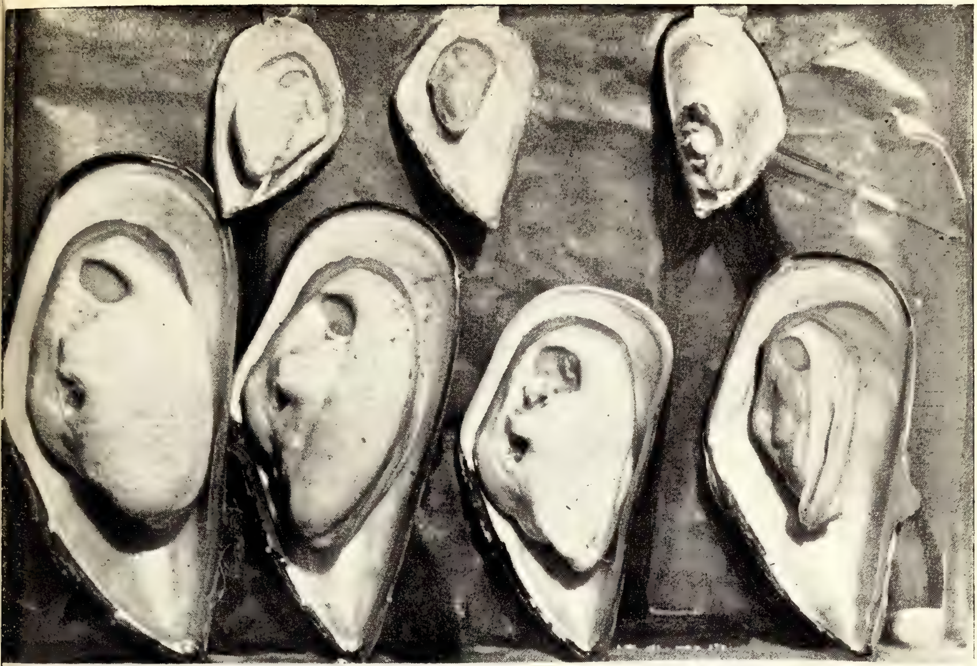
[1] 'Muthu' means pearl and as such '*muthuvachippi*' means pearl-bearing mussel.

[2] The general belief is that in December to February, which is the season of the ripening of the tamarind fruit, the mussel grows lean and with the flowering of the dadap (*Erythrina indica*) which is in about April the flesh becomes fat, developing a pinkish colour. These are of course only seasonal coincidences.



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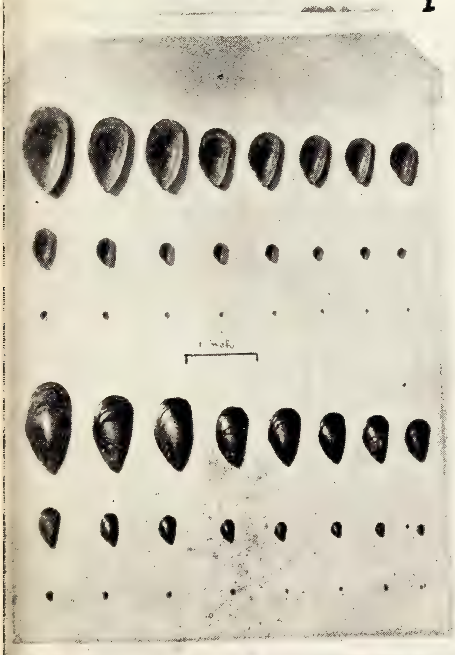

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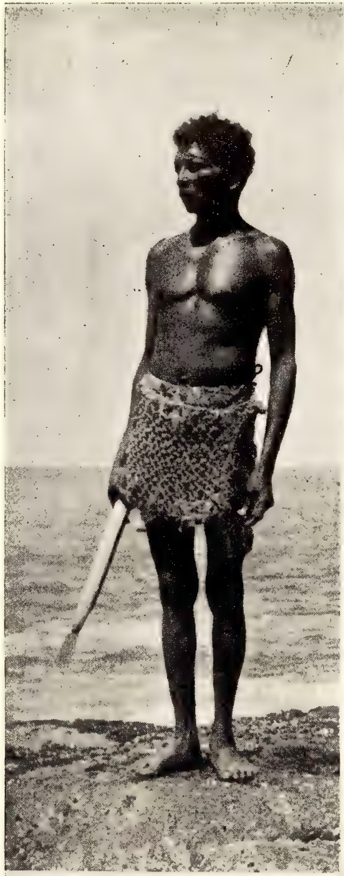
Photos by *Author*

For explanation see p. 528



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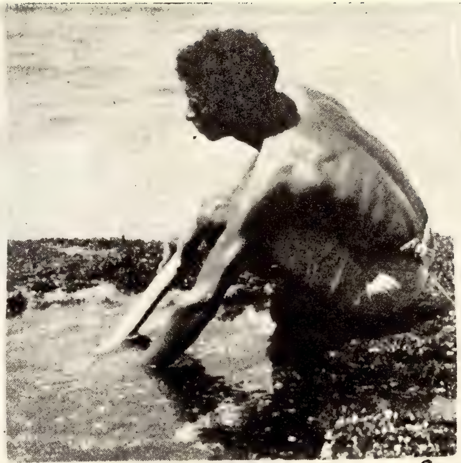

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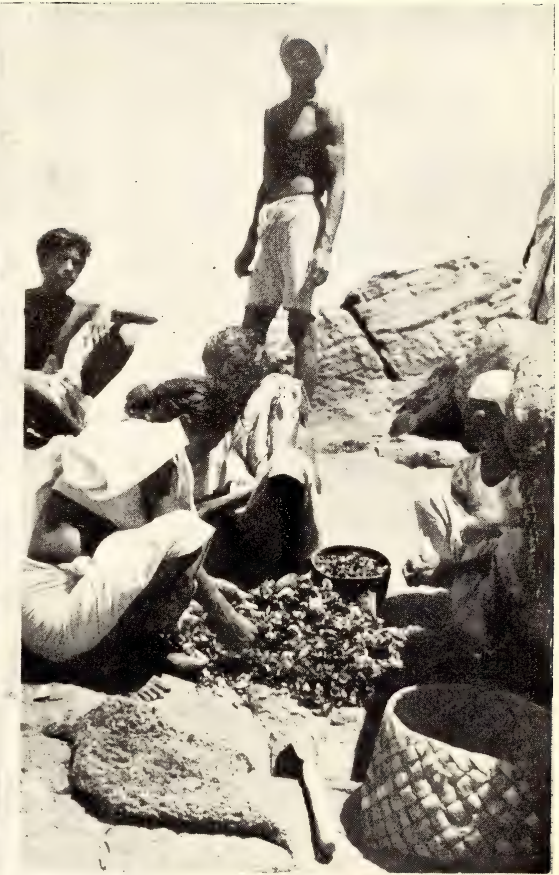

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Photos by *Author*

For explanation see p. 528

In the northern section between Poovar and Kovalam, fishing is done mainly by Pulayas[1]. These people do not belong to the true fishing communities like the Mukkuva (Christian), the Nulaya or Araya (Hindu) and the Marakkan (Muhammedan). Apart from shell-fishing and conch-fishing some Pulayas have taken to line fishing mostly when there is no mussel fishing. It is a great advantage to these people that the main agricultural operations are done during and between the south-west and north-east monsoons when shell fishing is rather difficult and is rarely done. In places south of Poovar, this fishing is mainly done by the Mukkuva or the Christian fishermen.

The fishing implements (Plate II, 1 & 4.) are very simple consisting of a coir bag known as *maal* and a large blunt chisel known as *uli*[2] The *maal* is nothing but a crude rectangular close-meshed coir bag about $1\frac{1}{2}$ ft. long and 1 ft. broad with two small coir ropes on either side so as to enable it to be tied on to the waist. *Uli* is a crude chisel consisting of a stout softwood handle about 18 inches long and about $1\frac{3}{4}$ inches in diameter with a blunt edged iron blade about 3 inches wide. The basal portion of the blade which is narrow and tapering is driven into the handle and is fixed tightly by an iron hoop. The handle is shaped out mostly by the men themselves in their spare time from softwoods like dadap (*Erythrina indica*) or silk cotton (*Bombax malabaricum*). In water it floats with the blade end down and the handle up and the buoyancy of the *uli* prevents it from being lost. In South Canara and Malabar coasts any hardwood sharpened at both ends is used for the collection of Green Mussel, whereas on the Bombay coast according to Rai (1932) an iron chisel is used for the purpose.

During the later part of the fishing season of the brown *Mytilus* the men have to go off the shore, usually in catamarans (Plate III, 2) and the fishing appliances are the same except that the *maal* is a very large one known as 'kottumaal' or foldable bag which is kept on the catamaran.

Attired in a scanty loin cloth the fishermen tie the *maal* in front at the waist and with the *uli* in hand (Plate II, 1.) jump into the water. The men are good divers and sturdy swimmers and are capable of remaining in water for quite a long time.

Before getting into the sea the fisherman makes a quick gesture of 'namaskaram' for heavenly protection and at the correct time when the wave heaves back he dives into the water. Combined with the pull of the sea and his own efforts he soon finds himself beyond the danger zone (Plate I, 3.). He dislodges the mussels from the submarine beds with his *uli* and fills the *maal* occasionally coming up to the surface to breathe. Getting back to the rocks with the heavy load of mussel is a very difficult task. He waits at the border zone and, at the correct interval between two swells, clambers up the slippery and precipitous rocks with the left hand supporting the mussel-filled *maal* (Plate I, 4.). The fishing is usually done from about 9 or 10 o'clock in the morning to about 2 or 3 in the afternoon. A bright sun and a clear sea are essential for this purpose. No fishing is attempted when it is raining or when the sea is very rough or when there is *kara* which causes considerable irritation to the eyes. The tidal effect is not much in these parts and tides do not appear to play a decisive part in the fishing operations though diving is more convenient at low water. Spring tide period is generally avoided.

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[1] Pulayas, also known as Cherumas, have been defined 'as a Malayalam caste of agricultural serfs and as members of an inferior caste in Malabar, who are, as a rule toilers attached to the soil' (E. Thurston : 'Castes and tribes of Southern India', Vol. II. p. 45.)

[2] The pre-war cost of an *uli* was about 8 annas and a *maal* about 6 to 8 annas.

Gradually the submerged rocks close to the shore get depleted and the men swim further out in search of fresh grounds. As this becomes more tiresome by the increase in distance, three or four men co-operate and hire out catamarans if they do not have their own, which serve as a temporary advance base for their operations (Plate II, 3.). In some parts, especially in the far south, the fishermen have their own catamarans. Here the catches are mostly landed on the beach where customers gather for the purchase of the mussel. Catamaran fishing of distant beds is common near Vizhinjam, Muttam, Kolachal and Kanyakumari (Cape Comorin) where there are certain rocks, like Kulathunkal, Adumechanpara, Keekal, Melekkal and other places, away from the shore.

In the course of *Mytilus* fishing certain subsidiary catches are also brought up. They consist of a species of *Purpura* which is one of the common edible marine gastropods in these parts. Some call it 'Kalchank' meaning rock gastropod to distinguish it from other chanks. This is in good demand and as compared to the pre-war price of 2 annas per hundred now fetches 8 to 12 annas. Lobsters (*Panilurus* sp.) are also sometimes caught and now fetch 8 to 12 annas each according to the size. This is about 4 to 6 times the pre-war price. Occasionally they bring up the sea urchin, *Stomopneustes* sp., as well, the gonads of which are considered delicious and consumed raw by the fishermen.

Sales:—Most of the sales of the Brown Mussel are effected on the rocks or at the shore soon after the mussel is landed (Plate II, 4.). The men seldom carry away the stuff for sale, but dispose them off immediately to the consumers and retailers, the latter conveying them to the neighbouring markets for sale. When the mussels are brought ashore by the fishermen they are mixed up with an amount of empty shells, barnacles and weeds and the cleaning up and sorting of the good ones is usually done at the spot.

Prices:—There is considerable difference between the present (1947) and pre-war prices.

Pre-war price of a bag (*maal*) of small mussel	½– 1 anna.
Present ,, ,, ,, ,, ,,	3– 4 annas.
Pre-war ,, ,, 100 large mussel	2– 3 ,,
Present ,, ,, 100 ,, ,,	12–14 ,,

The average earning of a fisherman on a day's fishing before the war was about 6 annas whereas now it is about Rs. 2 and sometimes even more.

Shells:—An important by-product of the industry is the shell which fetches good price for the manufacture of lime. The dead and rejected shells left on the shore at the time of sorting are also utilized for the purpose. Some use the shells for manuring the coconut farms. As Hornell (1921) says in the case of Green Mussel in Malabar, kitchen middens of discarded shells of Brown Mussel are quite a common sight behind houses in the coastal tracts of South Travancore. They are either sold to lime burners or used as manure in gardens.

Pearls:—Pearls are occasionally found in the large sized shell-fishes and these vary in size from a tiny pin-head to that of a pepper-corn (the largest the author has seen) in very exceptional cases. No one searches for the pearl and there is no trade in it. When cooked *Mytilus* is eaten, the 'pearl bite' could be distinguished from a 'sand bite' by the hardness of the former. There is a common belief among the local people that a pearl is killed when boiled whereas, a pearl from a live mussel would continue to grow if thrown back into the sea or if kept in a vessel of clean sea water.

Methods of consumption:—The tuberous root of tapioca or cassava cut into fairly large sized pieces, 1 to 3 inches in length, are put in an earthen cooking vessel with a little water for boiling. Over the roots the shellfish are kept and boiled. By the time the roots are cooked the shellfish also get cooked. After draining off the water the members of the family sit around and eat (Plate III, 4.). Saltwater from the mussel imparts sufficient taste to the roots and effects economy of salt, and cooking both together saves time and firewood and obviates the necessity for two vessels. A large number of the poorer classes consume mussel in the above manner.

Some boil the shellfish and eat the flesh by itself or with rice or cassava root. Sometimes the raw flesh is removed and prepared as a separate dish.

The raw mussel flesh is relished by some (Plate III, 3.), but it is seldom consumed thus as a regular item of food. Only the poorer classes are accustomed to it.

Though the drying of mussel is not at all in vogue, the writer has experimented on sun-drying of boiled as well as fried mussel meat. Both could be sun-dried and the stuff is very tasty and keeps well for a number of days. In this connection the findings of Humphrey (1941) in the case of the Australian Rock-oyster that it could be dried without significant loss of glycogen and protein are of interest. It is quite likely that this may be the same with our marine mussels[1] in which case they could be dried with advantage if and when heavy crops become available.

Associated animals:—Though on the surface of the shell it is common to see various kinds of sedentary and free living marine organisms, an interesting feature is the presence of a tiny crab, *Pinnotheres* sp., which somehow or other finds comfortable shelter inside. In view of the protection derived the necessity for a shell within a shell is obviated. It is very soft bodied and females are much more commoner than the males which are only rarely met with. The former develops a pinkish tint when filled with gonad and though small is tasty. Similar crabs have been found in the Rock Oyster, *Ostrea cucullata,* but their specific position is also not known[1].

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[1] The writer could not find any record as to the nutritive value of the mussels of the Indian waters. His efforts to get the meat of the Brown Mussel analysed failed since the Nutrition Research Laboratory, Coonoor, could not undertake the examination of the mussel sent by him.

General Remarks and Suggestions

Though the Brown Mussel fishery is at present limited to the Cape region of peninsular India the contribution it makes towards the diet of the nation especially at a time when fish is scarce is of great significance. A higher yield of mussel helps indirectly to divert more of other fish from the coastal area to the interior markets. Despite this there is little data regarding the mussel fishery and from the reports of the various Fishery Departments it could be seen that the attention paid to it is very little.

This is one of the few fisheries in India wherein considerable degree of augmentation of production by more intense and judicious exploitation is possible with minimum expenditure. What is required is a practical approach to the problem after acquiring a thorough knowledge of the existing conditions. At present the following points require further consideration:—

1. Whether the Brown Mussel is overfished or underfished?
2. Do the fishing methods require improvement?
3. What measures are necessary for the increased output of the mussel?

The answer to the first question is definitely that far from being overfished the mussel is underexploited. Years of general observation show that apparently there is no depletion of the brood stock, and that year after year the littoral and fishable rocks get replenished with mussel spat from inaccessible beds. Though it has been said that the mussel is not overfished so as to cause the depletion of the brood stock it may be stressed here that considerable quantity of undersized shellfish is taken out during the early part of the season contributing towards the depletion of the accessible beds.

A general complaint that one hears from the fishermen is that the quantity fished by an individual now is less than in previous years in spite of increased time and labour spent. While the area fished and the quantity of crop have remained more or less static the number of fishermen has increased resulting in a decrease in per capita production. As already stated, the position regarding the fishable areas is rather disquieting. Though the removal of undersized specimens from crowded beds might be helpful in thinning them out and facilitating quicker growth, large scale removal reduces the number of survivors as a result of which considerable time and labour are wasted in searching for them in submarine crevices and ledges. The quantity thus obtained is so meagre that the men find it hardly possible to eke out a living. In certain mussel beds like Kulathunkal near Vizhinjam and Adumechanpara near Muttam due to their distance from the shore no fishing is done early in the season as a result of which the mussel grows to a fairly large size by the time it is collected.

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[1] Members of the genus *Pinnotheres* are well known as dwellers inside bivalves. The identification of the different species of *Pinnotheres* is rather difficult and this was not attempted. For recent records of *Pinnotheres* spp. from the Indo-Pacific region see Tesch (1918) 'The Decapoda Brachyura of the Siboga Expedition, II Gonoplacide and Pinnotheridae' [Siboga Expedition, Part LXXXV Monograph 39 C, pp. 149-295, De Ma, J. G. 1929, Bijdr. *Dierk.,* (Amsterdam), and Isabella Gordon, 1936-39, *Journ. Linn. Soc.,* London. XL.]

As regards the fishing gear, the *uli* and the *maal* in use appear to be satisfactory for the present. Possibilities of exploitation of the untapped regions have to be seriously considered and the correct depth to which the mussel occurs should be ascertained. A survey of the mussel beds and all submarine rocks likely to sustain this and other related edible molluscs should be made. A chart based on this would indicate the desirability, if any, for improvements and alterations in the existing methods.

The third and the most important matter for consideration is the ways and means for increased production with adequate conservation. In view of the meagreness of our existing knowledge of the biology, distribution and extent of stocks of the shellfish any suggestions towards improvement of the industry can only be tentative. It has already been stated that so far as observations go the question of over-fishing or depletion of brood stocks has not arisen though the fishing of undersized specimens is a widely prevalent evil requiring prevention. The conservation of selected deeper areas for late season fishing could be done with advantage, and the economics of this measure could be studied. A complete closure of the fishing grounds cannot be suggested since it is neither desirable nor practicable. Though there is absolutely no dearth for mussel spat it may be too premature to think of spat collection for mussel culture, except as an experimental study. The natural enemies and parasites of the mussel also remain to be studied.

The most important and essential information we should possess is correct statistics of the fishery. Our country can ill-afford to relegate into the background as unimportant any item of food supply, the production of which could be augmented by proper conservation of the natural resources without any outlay. It is an accepted principle that in such matters the return is calculated in terms of the cumulative benefit to the nation rather than in terms of immediate cash return.

More than a quarter of a century ago Hornell (1921) while dealing with one of the weaving mussels, *Modiola tulipa,* which is common in Palk Bay forming extensive beds, said: 'The average size is not too small for food purposes, and were there any demand, tons of them could easily be dredged in Palk Bay. The larger species is excellent eating, while the smaller would make, dried and pulverised, poultry meal and fertilizer'. Apparently nothing seems to have been done since then.

In the race between our limited and insufficient food resources on the one side and a teeming and ever increasing population on the other, unless every resource is harnessed, we may be compelled to depend indefinitely on outside supplies for our internal demands. The case of our mussels is but one example of many and it is gratifying that the varied problems regarding the aquatic food resources of our country have begun to receive attention.

ACKNOWLEDGEMENT

I am grateful to Dr. S. L. Hora, Director, Zoological Survey of India, for kindly going through the paper and communicating it for publication.

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EXPLANATION OF PLATES

Plate I:

1. Boiled Brown Mussel with one valve removed showing the flesh inside. The three in the upper row are 4—5 months old. The left one is in good fat condition. The central one is in medium condition. The last mentioned has a *Pinnotheres* crab inside and the dorsal side of it could be seen in the photograph. The mussel in the lower row are all second year-olds. The first three are in fat condition and the last one is lean.
2. Inner and outer views of a shell series collected at the beginning of the Brown Mussel season during the last week of August, 1946. The largest shell is about 2½ months old.
3. A diver swimming off the rocks, for mussel collection.
4. The mussel diver clambering up the slippery rocks supporting a 'maal' of mussel.

Plate II:

1. A Pulaya mussel-diver ready to enter the sea with the *maal* tied at the waist and the *uli* in hand.
2. With his attention on any sudden wave which would dash him against the rocks, the mussel collector is seen dislodging mussel from a rock pool.
3. Mussel collection near a catamaran which serves as a base of operations for a nominal payment in kind or cash till one *maal* is full.
4. A typical family group sorting out the mussel after fishing is over.

EDIBLE CHELONIANS AND THEIR PRODUCTS[1]

BY

M. N. Acharji, M.SC.

(Zoological Survey of India, Indian Museum, Calcutta).

On account of the food shortage that is at present prevailing in India, Fishery Departments of many Provinces and States are making special efforts to increase production of fish and to market it to the public in a wholesome condition and at cheap rates. The Chelonians[2] (Tortoises, Turtles etc.) as a valuable source of food do not, however, appear to have received adequate attention. Tortoises and turtles, are not only an excellent food, rich in proteins and other valuable nutritive elements, but a fishery of these animals, if conducted on proper scientific lines, will provide employment for a considerable number of persons and will also help in setting up small scale industries in tortoise-shell, turtle-oil, etc. One great advantage in the fishery of these animals is that they can be kept for a considerable time out of water and do not suffer any appreciable deterioration in their edible qualities.

Turtle farming is a flourishing industry in Mexico, Japan and other countries. In some parts of India, notably in Assam and Bengal, considerable quantities of chelonians are caught and eaten. The Santals and some other tribes in Rajmahal relish tortoise[3] and, according to Annandale[4], the meat of *Kachuga dhongoka* Gray, commonly known as *Dhundi* or *Dhoor,* is relished even by the Brahmins[5].

Chelonians may be broadly classified into three groups, according to their habitat, *i.e.,* Marine, Freshwater and Land forms. A brief and general account of those species which are valued as food, or have some other commercial or semi-commercial importance is given below.

I. MARINE FORMS

Dermochelys coriacea (Linn.) is the largest of all living marine turtles; specimens weighing half a ton have been recorded. It is a great wanderer, travelling from ocean to ocean, and generally distributed in the tropical seas, and found in abundance on the coasts of Ceylon. It has no value as food, but eggs are highly prized. Babcock[6] has recorded that the inhabitants of the tropical islands extract oil out of the thick carapace of this animal. Deraniyagala[1] states that the oil is used as canoe preservative of considerable value. A specimen was sold at Colombo for Rs. 30.

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[1] Published with the permission of the Director, Zoological Survey of India.

[2] The term Chelonian has been used in a broad sense. It includes marine, freshwater and land forms.

[3] Chaudhuri, B. L., *Rec. Ind. Mus.* VII, p. 212-214 (1912).

[4] Annandale, N., *Journ. Asiat. Soc. Bengal* X, p. 137, Foot-note (1914).

[5] In the ancient law books of the Brahmins, the meat of tortoises is not forbidden.

[6] Babcock, H. L., *P.Z.S.* (London) CVII, p. 595 (1937).

Eretmochelys imbricata (Linn.), known as Hawksbill Turtle, is distributed in the tropical and subtropical seas. The flesh is dark, coarse and very seldom eaten. The much valued 'tortoise-shell' of commerce is derived from this species. From a single specimen as much as 10 lbs., of tortoise-shell may be obtained. Watt[3] has stated that sometime the price of a single specimen goes up to £ 4, though it naturally depends on the quality of its shell. The finest shell, according to Watt, is obtained from the Western Archipelago, but is exported from the southern coast of the Indian continent, Ceylon, the West India Islands and Brazil. In India tortoise-shell is largely used in making ornamental articles in Vizagapatam.

According to Babcock (*loc. cit.*, 1937, p. 601), 4980 chelonians were exported from Jamaica during the year 1929-31, valued at £ 10,097. Deraniyagala[3] has given the export figures of *Eretmochelys* scutes, based on the returns from the Ceylon Customs department.

Chelonia mydas (Linn.), the well-known Green Turtle is the animal from which the highly prized turtle soup is prepared. It has got a very wide distribution, occurring in tropical and subtropical seas. It is found in abundance near the Andaman Islands, and on the Rangoon coast. Maxwell[4] stated that there was a regular trade in these chelonians between Calcutta and the Andaman Islands. In the Nicobar Islands, these animals were extensively killed by 'pegging', and consumed by the local inhabitants.

Sometimes this turtle attains a weight of 400 lbs. The eggs are laid near the sea beach by digging holes at a safe distance from the water-mark. The chief egg-laying period is between July and November. Generally 66 to 195 eggs are laid by a single female. Maxwell (*loc. cit.*, 1911, p. 8) has recorded that the annual collection of eggs of the Green Turtle in the Irrawady division of Burma is about 1,600,000 or more. The Burmese are very fond of chelonian eggs, and the entire catch, therefore commands a high market price; sometimes in bigger cities like Rangoon, the eggs used to be sold at a fancy price. According to this author the eggs are very rich in food value and have a taste somewhat like that of marrow.

In Ceylon these animals are netted from November to March, and are kept in a pen specially constructed for the purpose in the sea near the beach, from which they are transported to the market according to the prevailing demand. In each season the catch runs to about 1,000 turtles. Deraniyagala (*loc. cit.*, 1930, p. 66, footnote) observed that turtle flesh is in great demand in the Jaffna (Ceylon) market. An adult turtle will fetch from Rs. 40 to Rs. 70. The Hindus are amongst the chief consumers of this meat. The flesh and blood of this species are said to have some medical properties in curing haemorrhoids.

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[1] Deraniyagala, P.E.P., *Spol. Zeyl.* XVI. p. 52 (1930).
[2] Watt, G., Dictionary Economic. Products VI, part 1, p. 433 (1892).
[3] Deraniyagala, P.E.P., Tetrapod Rept. Ceylon 1. p. 190 (1939).
[4] Maxwell, F. D., Report Inland Sea Fisheries (Rangoon), p. 4 (1911).

Babcock (*loc. cit.* 1937, p. 601) has given statistics of the number of chelonians exported from Jamaica (mainly received from the Cayman Islands, and some from Costa Rica and Nicaragua). From the year 1929 to 1931 Green Turtles, numbering 6346, and valued at £1262 were exported. Besides these, a good number of these animals were carried away to New York from Port Limon by the United Fruit Company's boats, but no figure is available.

II. Freshwater Forms

Geoemyda trijuga (Schweigger) is a freshwater species. There are four subspecies found within Indian limits. It is an inhabitant of still water, ditches and ponds and is found in abundance in Bombay and Madras Provinces and also in some parts of Mysore. According to Smith[1] it has recently been introduced into Calcutta. *Geoemyda trijuga thermalis* (Lesson) is found in Ceylon and in the southern parts of the Indian peninsula. Both *Geoemyda trijuga* (Schweigger) and *Geoemyda trijuga theralis* (Lesson) are edible and much hunted for food.

Hardellathurgi (Gray) is another freshwater tortoise. It is found in the Ganges and Brahmaputra river systems. According to Anderson, it frequents slow-flowing and stagnant waters. In the winter months large numbers of this species are brought to the Calcutta market, where they are readily sold. Anderson[2] has described a very interesting method of catching this species in the Purneah district of Bihar.

Almost all the species of the genus *Kachuga* (Gray) are edible and their flesh is much esteemed as food. *Kachuga* has a wide range of distribution and is found in almost all the river systems of India. Six distinct species are recorded within Indian limits, *viz., Kachuga smithi* (Gray), *Kachuga tectum* (Gray), *Kachuga sylhetensis* (Jerdon), *Kachuga dhongoka* (Gray), *Kachuga kachuga* (Gray) and *Kachuga trivittata* (Dum. & Bibr.). *Kachuga dhongoka* lays a larger number of eggs than any other species of the genus. Eggs numbering between 30 and 35 are generally laid in sand banks. They are elongate in shape, ca. 55 × 33 mm. in size, and have a very delicious taste.

Batagur baska (Gray) is aquatic and herbivorous in its habits. It is found in 'Bengal, Burma to Cochin-China and to the Malay Peninsula; Sumatra'. The flesh is very much liked by the Burmese who catch this species in large numbers by means of basket-traps specially made for that purpose. Eggs laid by a single female in one night vary from 10 to 30 in number. During the course of six weeks' time about 50 to 60 eggs are laid by a single individual. The eggs measure from 70-79 mm. in length, 40-45 mm. in breadth and weigh about three ounces each. The carapace of the species, as stated by

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[1] Smith, M. A., Fauna Brit. India (Rept. & Amph.) I, p. 98 (1931).
[2] Anderson, J. Zool. Res. W. Yunnan, p. 771 (1878).

Maxwell (*loc. cit.*, 1911, p. 15), has some commercial importance, as it is of great value to the salt boilers.

Amongst the Mudturtles (Trionychidae), species of **Lissemys** Smith and **Trionyx** Geoffroy are mostly used by people as food. According to Annandale[1], these animals are caught in large numbers near Khulna (Bengal), and are transported to the Calcutta market for sale. When the demand is low, the animals are stocked in ponds near Calcutta with their legs fastened together, thereby arresting their movements. Under such conditions they live for months, till such time as they are finally disposed off. From Goalando[2] and Sunderban areas large quantities of these turtles are brought down to Calcutta and the neighbouring towns, packed in wooden crates and reed or wicker baskets. In Calcutta market the pre-war price of the flesh of these turtles was from six annas to ten annas a seer. Annandale (*loc. cit.*, 1912, p. 157) found that most of the turtles sold in Calcutta market were *Trionyx hurum* Gray and not *Trionyx gangeticus* Cuvier. In South India *Lissemys punctata granosa* and in Burma *Lissemys punctata scutata* are found in abundance and are consumed by the inhabitants of those places.

III. LAND FORMS

Testudo elegans Schoepff, known as 'Starred tortoise', is distributed throughout central and southern India, extending as far south as Ceylon. It is the common tortoise found in Madras Province. The flesh is eaten by the lower classes of people. In Burma it is replaced by *Testudo platynota* Blyth, the flesh of which is greatly esteemed by the Burmese. Blyth[3] stated that in Burma the carapace of this species was used for bailing oil out of earthen vessels. *Testudo emys* Schlegel, is another species found in Assam, Burma and Siam. In India it is the largest of the land tortoises and is chiefly hunted for its flesh.

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[1] Annandale, N.: *Rec. Ind. Mus.* VII, p. 156 (1912).

[2] Mr. M. N. Dutt of the Zoological Survey of India while on tour in East Bengal in 1937, saw a large number of chelonians packed in wooden crates and in wicker baskets awaiting despatch to Calcutta at almost all the steamer stations of the I.G.S.N. Company.

Dr. S. L. Hora informs me that on the Khulna Section of the Eastern Bengal Railway he has seen large number of chelonians kept on the platforms of stations upside down and with their legs fastened together for despatch to Calcutta.

[3] Blyth, J.: *Journ. Asiat. Soc. Bengal*, XXXII, p. 83 (1863).

REVIEWS

1. ELEPHANT BILL. By Lt.-Col. J. H. Williams, O.B.E., with a forward by Field-Marshall Sir William Slim, G.B.E., K.C.B., D.S.O., M.C. Pp. 320, plates 42, drawings 2 and maps 4. London, Rupert Hart-Davis, 1950. Price 18*s*.

Lt.-Col. Williams, after gaining experience of camels and mules in World War I, joined the staff of the Bombay Burma Trading Corporation in the teak forests of Burma. After some twenty years' close acquaintance with elephants both tame and wild in that country, he became 'Elephant Adviser' to the XIV Army when the Japs had overrun Burma in World War II. The result of these twenty-five or so years' intimate connection with Burmese *oozies* and their elephants has resulted in a well printed and profusely illustrated book which has proved to be a very readable best-seller. I understand it has already been reprinted twice this year. This is understandable, for the book is written in a popular, graphic and lucid style, and gives an intimate and first-hand account of elephants in a country whose men and forests cannot but appeal to all except the most unimaginative. When, however, the author briefly leaves the familiar ground he knows so well to venture into the field of the zoologist and historian, he is liable to trip up. His division of African and Asiatic elephants into races is both arbitrary and unscientific; and he finds it difficult to believe that the elephants used by the Carthaginians against Rome were of African origin, as 'no tradition of elephant-training has survived in Africa . . . .' Evidently he was not aware that elephants existed in considerable numbers in the northern parts of Africa in classical times, but were exterminated by the Romans by the year 550 A.D. It would have been much easier for the Carthaginians to capture and train these, than to import Indian elephants from Asia as suggested by the author.

The first part of the book under review is of greater appeal, especially to the lover of elephants and the jungle, and as such is a useful contribution to our knowledge. The second part falls more into the category of a war autobiography, though considerable interest is aroused in the reader by the description of the epic march of the elephants from Manipur into Cachar, led by that fine tusker Bandoola.

E.P.G.

2. A SHORT GUIDE TO THE NATURAL HISTORY SECTION IN THE PROVINCIAL MUSEUM, LUCKNOW. By M. M. Nagar, M.A., U.P.E.S. Pp. 1-24; 26 plates (coloured and half tone). Superintendent, Printing & Stationery, U.P., Allahabad (1950). Price Rs. 1-14-0.

The Society has received a copy of this unhappy publication for review. The 24 pages of text make poor reading and contain a generous sprinkling of loose and incorrect statements. Among the more astounding items of information we gather, for instance, that the Baya is "the most skilful nest builder and glues particles of foreign matter with its sticky saliva . . . . ." and that sunbirds, bee-eaters and starlings "are small perching birds renowned for their melodious notes".

We learn that "the tern or sea swallow is the size of a house sparrow with a glossy steel blue above and pale pinkish-white below, often seen in numbers huddled together on telegraph wires".

Scholarly and illuminating is the observation that "the eyes of birds are so peculiarly formed that they can alter their focus from a distant object to a nearer one almost instantaneously. Hence goes the proverb birds-eye view"!

Many of the plates which comprise more than half of this 'Short Guide' are veritable eyesores. The coloured plates in particular—which unfortunately are also the most expensive to reproduce—though alleged to represent definite species are often mere splodges; 'disgraceful' is the only adjective that will describe them adequately. Both from the aesthetic and the scientific points of view many of the plates are thoroughly worthless, and it seems little short of criminal that under our present economic stress the taxpayer's money should be squandered in publishing such stuff in the guise of education for the masses or the 'popularisation' of science.

Originality in simple descriptions of natural history museum exhibits seems uncalled for, and indeed is not expected from people who may not be naturalists. But there are good published works on Indian natural history available from which authentic information could have been easily extracted so that these inaccurate and fanciful descriptions are quite inexcusable.

S.A.

3. BIRDS OF CEYLON I. By W. W. A. Phillips, F.L.S., M.B.O.U., F.Z.S. Pp. 32, 1 coloured map, 4 photographs by author; 20 coloured plates by Mrs. G. L. Lushington. Colombo (1950): Ceylon Daily News Press. Price: popular edition Rs. 3; Library edition Rs. 5.

No recent Ceylon ornithologist has more original field work to his credit than W. W. A. Phillips. This attractive and handy little booklet—which is the first of a series of four, intended to cover about a hundred species in all—is a laudable effort on his part to interest and assist the beginner in the study of birds. The descriptions are simple and concise, and the coloured plates illustrating some common birds—though they have suffered from the printer's inevitable mauling—from a useful complement to them.

Mr. Phillips's proficiency as a bird photographer is well known and the beautiful originals of his photos, here reproduced, have excited the reviewer's envious admiration ere now. It is therefore all the more disappointing to find such scant justice done them by the printer.

On p. 3 'Red-backed Shrike' is obviously a slip, since this species (*Lanius collurio*) does not occur in Ceylon.

The hints on bird watching which conclude the book should be of great help to the beginner.

Further parts in this series will be awaited with keenness.

S.A.

The following books have been added to the Society's Library since July 1950:—

1. A HAND-LIST OF THE BIRDS OF IRAQ. By Bashir E. Allouse (Iraq Natural History Museum publication, No. 2, 1950).

2. AN INDEX OF MINERAL SPECIES & VARIETIES ARRANGED CHEMICALLY. With an Alphabetical Index of accepted Mineral names and Synonyms. By Max H. Hey (British Museum, 1950).

3. THE HOUSE-FLY—Economic series No. 1, Fifth Edition. By Max H. Hey [British Museum (Natural History), 1950].

4. FISHERY STATISTICS OF THE UNITED STATES 1946—Statistical Digest No. 19 Fish & Wild-life Service. By A. W. Anderson & E. A. Power (United States Government Printing Office, Washington. 1950).

5. AGRICULTURE IN INDIA. (The Publication Division, Ministry of Information & Broadcasting, Government of India, 1950).

*6. 'EPITOME' DE BOTANIQUE ET DE MATIERE MEDICALE DE LINDE THESE By Lucien M. Giboin (Impremerie de Sri Aurobindo Ashram, 1949).

7. UPLAND GAME BIRDS—The American Sportsman's Library. By Edwyn Sandys & T. S. Van Dyke (The Macmillan Company, 1902).

8. SALMON & TROUT—The American Sportsman's Library. By Dean Sage C. H. Townsend, H. M. Smith & William C. Harris (The Macmillan Company, 1902).

9. ELEPHANT BILL. By Lt.-Col. J. H. Williams (Rupert Hart-Davis 1950).

10. THE GEOGRAPHY OF THE FLOWERING PLANTS. By Ronald Good (Longmans Green & Co., 1947).

11. SYNOPSIS OF PROPOSALS CONCERNING THE INTERNATIONAL RULES OF BOTANICAL NOMENCLATURE SUBMITTED TO THE SEVENTH INTERNATIONAL BOTANICAL CONGRESS—STOCKHOLM 1950. By J. Lanjouw (Ag. Rapporteur General) (The International Commission of Taxonomy of the I.W.B.S., 1950).

12. A SHORT GUIDE TO THE NATURAL HISTORY SECTION IN THE PROVINCIAL MUSEUM, LUCKNOW. By M. M. Nagar (Superintendent, Printing & Stationery, Allahabad, U.P., 1950).

13. STUDIES ON BATS AND BAT PARASITES especially with regard to Sweden and other neighbouring countries of the north. I. By Olof Ryberg. (Bokförlaget Svensk Natur, Stockholm, 1947).

14. FISHES OF THE IRANIAN GULF—Reprint from Danish Scientific Investigations in Iran, Part III. By H. Blegvad, assisted by B. Löppenthin. (Einar Munksgaard, Copenhagen, 1944).

15. VÅRA FÅGLAR—Och hur man känner igen dem—(Swedish birds). Del I. By Rudolf Söderberg. (Albert Bonniers Förlag, Stockholm, 1950).

16. VÅRA FÅGLAR—Och hur man känner igen dem—(Swedish birds). Del II. By Rudolf Söderberg. (Albert Bonniers Förlag, Stockholm, 1950).

17. VÅRA FÅGLAR—Och hur man känner igen dem—(Swedish birds). Del III. By Rudolf Söderberg. (Albert Bonniers Förlag, Stockholm, 1950).

18. VÅRA FÅGLAR—Våra Fåglars ägg och bon—(Swedish birds' eggs). Del IV. By Rudolf Söderberg. (Albert Bonniers Förlag, Stockholm, 1950).

19. STUDIES IN BIRD MIGRATION being the collected papers of H. Chr. C. Mortensen (1856-1921). Edited by Poul Jespersen & Å. Vedel Tåning. (Dansk Ornithologisk Forening, Munksgaard, Copenhagen, 1950).

20. DEN FLYGANDE DRAKEN (The Flying Dragon). By Bengt Berg. (P. A. Norstedt & Söners Förlag, Stockholm, 1931).

21. GRÖNLANDS FUGLE (The Birds of Greenland). Part I. By Finn Salomonsen, with plates by Gitz-Johansen. (Ejnar Munksgaard, Copenhagen, 1950).

22. SVENSKA FÅGLAR (18 coloured plates of Swedish birds). By M. och W. von Wright, (Förlaget Svenska Fåglar, Stockholm, 1925).

23. WEBS IN THE WIND. (The habits of web-weaving spiders). By Winifred Duncan. (The Ronald Press Company, New York, 1949).

24. REPORT ON THE LIONS OF THE GIR FOREST. By M. A. Wynter-Blyth. (May 1950).

MISCELLANEOUS NOTES

1. A TIGER FIGHT

The Cachari villagers living a mile east of Jhargaon jheel, which is between 3 and 4 miles south of Rowtabagan railway station in Darrang, Assam, reported a terrific noise as of tigers fighting on the night of 30th/31st January last.

On the morning of the 31st they went to see what had happened and in heavy grass found a dead tiger lying on its back, severely mutilated. An amphitheatre of flattened grass, about 15 feet across showed there had been great struggle.

Report was sent to camp on 1st February and these are the mutilations I noted on inspection:

The lower jaw had been wrenched off; both fore limbs had been chewed off at the elbows leaving stumps; the abdomen had been torn open and allowed the stomach to protrude; the external genitals were removed as with a knife, and the tail was nipped off leaving a stump a foot long.

Also the 3 middle claws of the left foot were missing but otherwise the hind limbs were intact.

There was no sign of jackals or vultures having touched the corpse and I visited it again as late as 3rd February when it was maggoty and decomposition well advanced.

I was in camp at Rowta during December and January and after tiger. A tigress with 2 cubs was reported 3 miles north-west of camp, and the cowherd, who saw her killing and hauling one of his buffaloes to cover, said she had an enormous head.

She shifted 3 miles east, to the left bank of the Dhunsiri river where a cultivator saw the cubs. Then I lost trace of her; she must have recrossed the river and gone to the Jhargaon jheel area some 2 miles south of my camp where Cacharis saw the cubs. Another tiger, which I consider is the animal of this tale, I tracked on the left bank of the Dhunsiri on 9th January when enquiring about the tigress. His large pugmarks were followed downstream till he crossed the river and up the right bank to an outlier of Rowta tea-garden.

My elephants were hobbled there and were restless and trumpeted on the night of 8th/9th January when the tiger arrived. He called several nights, made no kills around and left, evidently for the Jhargaon jheel surround. I had to close my camp and sent my elephants away on 1st February, before news of this kill came in, so I was unable to search for 'the other party' or trace the missing parts in the very heavy grass and 'tarapat' round the jheel.

The tiger killed was a big old animal judging from his pale coloured skin and worn teeth. The conclusion I came to was that the two animals I tracked had met and fought. The cubs were born after the poojahs of 1949 and would be just over 3 months old at the time of the fight.

DARJEELING,
1st March, 1950.

W. D. RITCHIE,
Lieut.-Col. I.M.S. (Retd.)

2. DEATH CRY OF TIGER

In my note on the above—Vol. 48, No. 1, p. 176.—I said I had not anywhere read of this cry having been recorded. I find that this cry was mentioned by Mr. W. S. Thom in his exhaustive article 'Tiger Shooting in Burma' published in Vol. XXXVII where he writes (p. 596) as to sounds uttered by tigers, 'I have heard them all, the cat-like call made by a wounded tiger on the point of death, a whine, a husky half suppressed kind of grunt, a snarl, a purr, a miaow and the "tak" referred to by Mr. Peacock in his book.'

BANGALORE, R. W. BURTON,
3rd August, 1950. *Lieut.-Col.* I.A. (Retd.)

3. RABIES IN TIGER—TWO PROVED INSTANCES

In all the years of the Bombay Natural History Society since its foundation on the 16th September 1883, and the issue of the first *Journal* in January 1886, there has been no instance recorded of rabies in either tiger or panther. Now we have from Assam two proved cases of rabies in tiger, and a possible third instance. (Calcutta *Statesman* of 9th February 1946 and Miscellaneous Note by Mr. S. A. Christopher in Vol. 46, p. 391.)

There has also, so far as known to me, been no mention of rabies in tiger or panther in any of the more than 250 books published during the past 150 years on 'Big Game Hunting and Shooting in India and the East.' (Vol. 49, pp. 222-240.)

This is very strange, for it can be reasonably conjectured that cases must have occurred. Also one would think that panthers, being so partial to the killing of domestic dogs for food, would have been very many times exposed to possibility of contracting rabies through the fresh saliva of their prey. Possibly the known instances of tigers and panthers being found in the forests, and cause of death not apparent, were due to rabies.

First Case.—The narrative (condensed) of Mr. T. R. Clark, the then Manager of the Salonah Tea Estate in the Nowgong District of Assam, gives particulars of what happened.

'On the evening of 28 January 1943 one of three men cycling in the dark along the Salbari Road was attacked by a tigress (as it proved to be) and badly mauled. The two other men managed to drive off the animal, the cycle held up by one of them as a shield being bitten and clawed.

Further up the road some carts, carrying long mats extending well over the cart buffaloes, were attacked by the tigress which leapt from the bank at side of the road on top of the mats and was perched there for several yards. The men, sheltered by the long mats, managed to scare the animal away. Shortly after more carts carrying smaller mats came along. The tigress leapt on the buffaloes, dragged down one of the cartmen and badly mauled him. In the terrible confusion three of the men were seriously clawed and bitten, one of them suffering a fractured arm.

The cyclist was admitted to hospital early in the night and the cartmen were brought in about 8.30 next morning (29th Jany.) Not long after I motored along the Salbari road to see the places of attacks, and going on towards Langteng met Mr. Edwards, Assistant Manager, bringing in a woman and girl badly mauled on the road about 8.45 that morning. These having been admitted to hospital I sent Mr. Edwards to Nowgong, over twenty miles distant, with a letter to the Deputy Commissioner asking for elephants and shikaris.

About 2 p.m. a man cutting wood was brought in badly mauled. Later in the afternoon the Deputy Commissioner arrived, and Dr. Hugh Smith (Medical Officer, Nowgong Medical Association, Salonah) and I went with him to see the place where, it was just then reported, another woodcutter had been attacked. This was several miles distant from the previous place.

Arrived near the place it was getting dark so a lorry and other three men were obtained. With much difficulty the lorry was forced through as far as a small clearing, and after searching around for some time in the dark the man was heard to be faintly calling in reply. He was found to be badly torn, but conscious and sensible. The tigress could not have been far off, and having but a torch to show the way through rough scrub and jungle the party was rather helpless had the animal attacked, for firearms in such circumstances would have been difficult to use with proper effect.

At 6.15 next morning (30th) I went to Borghat to take two ladies to the railway station for the Darjeeling train. Passing through the estate labour lines it was found there was much excitement as the tigress had been seen in the vicinity.

Returning through the line with the ladies I stopped for information. Suddenly the chowkidar pointed, and there was the tigress quietly crossing the road about ten yards away and not even glancing towards the car! I rushed the ladies to the station, put them safely into the stationmaster's office, and then started off to get my gun from my bungalow and Dr. Smith with his heavy rifle. On my way I met Mr. Rogers of Amluckie Tea Estate who carried on to the station with his wife, who was also going to Darjeeling, while I proceeded to my bungalow. Mr. Rogers fortunately had his gun with him.

Now came the almost incredible climax. Arrived at the station Rogers got the luggage out of the Ford Vanette, turned the car round, and was sitting in the driving seat, his gun unloaded, when the tigress came walking along the road towards the car. He was unable to load the weapon in the confined space and could not risk getting out. The beast walked past, taking no notice of the car or of two bullocks tethered to a close-by cart. Rogers got out of the car, loaded his gun, and shot the tigress as it walked slowly and quietly away from him.

We learned later that the tigress had forced her way into houses in the lines; and in one instance, where a man with his wife and child tried to close the door against it, mauled the woman and child but did not attack the man.

The tigress was fully grown, perhaps three years old. Measurements were not taken, nor is there a photograph, which is a pity.

The brain was quickly removed and sent by train, held up for the purpose, to the Pasteur Institute at Shillong. Telegram 763 to the Medical Officer (Dr. Smith) reported *'Negri bodies in tiger's brain'* thus furnishing proof positive that the animal was suffering from rabies. (Note: *Negri* from 'negroid'—black bodies seen under the microscope.)

All the injured people were given anti-rabic treatment. Fifteen cases were treated in the hospital and eight of them died of their wounds. Two Mikirs (people of the Mikir Hills) and a Nepali woman were killed in the jungle. None of the survivors developed rabies. During the thirty-six hours of the 'terror' eighteen people were attacked of whom only seven survived. The cyclist, the first man to be attacked, died at the very moment the sound of the shot which killed the tigress was heard at the hospital. This coincidence quickly gave rise to much talk and conjecture among the superstitious!'

Second Case.—In a letter published in the Calcutta *Statesman* of 6th May 1950, Mr. M. N. R. Kemp of Saikhoa Ghat, Assam, stated that a tiger had attacked a village during the night of 16th April 1950, and in a further letter published on the 20th May followed up with information that the brain of the tiger was reported by the Pasteur Institute, Shillong, to contain *Negri bodies*. It appears that the tiger went from house to house in the village, attacking, mauling, biting and going on to the next house. In all 14 persons were mauled of whom one, a woman, died at once and two others in hospital. One man was bitten in the upper arm and suffered a compound fracture of the humerus. His wife it was who was killed outright and the two elder children bitten, while a small baby was unhurt. The tiger was shot at dawn by a local shikari—the length 9 feet 4 inches.

It is understood that Mr. Kemp will be elsewhere publishing an account of all that took place.

Pasteur Institute Report

In his letter of 8th July 1950 to Mr. Clark the Director of the Pasteur Institute, Shillong, Dr. S. R. Pandit, who has held the same post since May 1942, mentions that he quite well remembers the above two instances of rabies in the tiger as he had examined and reported on the sections from both. He mentions also that he has submitted a note of these two instances of proved rabies in the tiger to the *Indian Medical Gazette*. This has not as yet appeared but will perhaps be in the *Gazette* for the month of December.

A Third Case.—The Miscellaneous Note by Mr. S. A. Christopher under the caption 'A Tiger "Runs Amok" ' draws attention to an article relating that a tiger killed 7 coolies and was then killed in battle with a wild buffalo. Such an occurrence—seven men all killed at one spot in presence of other people, presumably in daylight in or near a village and a railway station, is certainly deserving of further enquiry. It has not been possible to get in touch with Mr. Christopher, and the place where the alleged incident took place not being known to me there is at present no further information available. On the face of it this seems quite likely to have been another case of rabies in the tiger.

How did the Tigers contract Rabies?

It is natural that people should wonder in what manner these tigers contracted rabies. As rabies virus cannot gain entry into the body other than through broken skin, and the virus has to be conveyed by means of *fresh* saliva, it follows that the two animals contracted the disease either by being bitten or wounded by some rabid animal; or (which is more likely) the virus in fresh saliva from some rabid beast they had killed, or fed upon, entered their bodies through some wound or abrasion, or some break in the skin of mouth or tongue. They may have licked the 'kill' and so licked fresh saliva and in that way have got the virus into their system. The smallest break in the skin would suffice, and that may have come about in a number of ways: a cut from a sharp bone on some part of lips or tongue; a scratch on the lips from a thorn; or any of many possible happenings.

Other peculiar Occurrences

Major A. St. J. Macdonald reminds me *in epistola* of several cases of tigers entering houses in a semi-conscious state, and refers to the account in the *Indian Forester,* a short version of which appeared in the *B.N.H.S. Journal,* Vol. 36. p. 235, to a happening in Upper Burma when a tiger walked into the Rest House by the front door, lay down, and afterwards got up and quietly left by the way he had entered. What was noticed more than anything else was the awful stench from the tiger's body and the swarms of flies even at that late hour of the night.

A third case, to which Major Macdonald was a witness, was that of a not fully grown tiger entering a cattle pen by day and lying down without paying any attention to cattle and calves tethered in the yard and in the shed. The animal was killed by spears while in a comatose state and found to be suffering from advanced blood poisoning as the flesh was of the colour of an over-ripe pear and highly oedematous. In this instance porcupine quills were the cause.

None of these happenings were occasioned by rabies.

BANGALORE, R. W. BURTON,
16th September, 1950. *Lt.-Col.* I.A. (Retd.)

4. THE 'DEW-CLAWS' OF THE HUNTING LEOPARD OR CHEETAH [*ACINONYX JUBATUS* (SCHREBER)]

I have not had the fortune to witness the sport of blackbuck hunting with aid of the cheetah. None of the accounts contained in shikar books are available to me just now so I turn to the 'Fauna of British India, Mammalia', Vol. I where the author, R. I. Pocock, F.R.S., describing the method of hunting from accounts available to him (for he will not have written from personal observation of the sport) says at page 329:

'The victim . . . . . . is usually apparently struck over by a blow of the Cheetah's fore paw, is then seized by the throat . . . . .'

One would think that the forearm and paw of the cheetah has not the muscular power necessary for such a feat, especially when it is borne in mind that the weight of the buck is about 90 lbs. It seems that it has not been related in the accounts available to Pocock exactly how the buck is struck down in full flight.

I have just come across the two volumes of a book titled 'The New Shikari at Our Indian Stations' by Colonel Julius Barras, 1885, and read at page 92 of Vol. I exactly why the cheetah is able to strike down the buck. Having described the preliminaries and circumstances of the hunt Barras relates:

> 'I now inspected the carcass of the deer (*sic*) with a view to ascertain if possible how the cheetah had been able so instantaneously to strike down such a powerful animal immediately on getting up with it. I at once observed a single, long deep gash in the flank which was evidently caused by the decisive blow. But I could not imagine with what weapon the leopard had been able to inflict this very strange-looking wound. Then, turning to the beast, as it sat on the cart, I inspected it closely and saw that the dew-claw which in the dog appears such a useless appendage, is represented in this brute by a terrible-looking talon exactly suited to the infliction of such a gash.'

So here we have it. It is not, as we can readily imagine, by a blow of the paw alone that the buck is struck down. Nature, to aid the cheetah's speed has provided almost dog-like nails to his four toes, but has retained for him the powerful, sharp, curved dew-claw to enable him to obtain the necessary purchase to overthrow the buck at racing speed. Without such a dew-claw the beast would probably not be able to strike the blackbuck down with the sureness he displays.

Comments on the above by members who keep cheetahs for the coursing of blackbuck would be interesting by way of confirmation or otherwise.

BANGALORE. R. W. BURTON,
10*th July*, 1950. *Lieut.-Col.* I.A. (Retd.)

[According to Dr. Edward Hindle, F.R.S., Scientific Director of the Zoological Society of London, to whom the question was referred, the general opinion concerning the 'dew-claw' in all animals where it is present is that it is a vestigial digit on its way to disappearance. He had not heard of the suggestion that in the cheetah it is used for striking and holding down prey, nor could he offer any information concerning its possible function in this animal. But K. S. Dharmakumarsinhji of Bhavnagar, who has considerable experience of hunting with trained cheetahs, comments as follows:

'The cheetah's main weapon of attack is the dew-claws without which it would be difficult for him to hold down large prey.

Our experience in hunting with cheetahs is that the dew-claws are made full use of as hooks for holding on to blackbuck once the animal has been contacted. Cheetahs with blunted dew-claws were not able to control full sized blackbuck as effectively as those that possessed sharp undamaged ones. We have found therefore that the dew-claw is very important to the cheetah and he can also inflict a severe wound with it.

Sometimes it is solely by means of the dew-claws that the black-buck is secured in the chase.'—EDS.]

5. NOTES ON THE CLOUDED LEOPARD [*NEOFELIS NEBULOSA* (GRIFFITH)]

(*With a plate*)

Early in April 1950 a specimen of the Clouded Leopard which had been killed by a Forest Guard in North Borneo, was sent to the Raffles Museum for identification.[1] This animal has a wide range from Nepal and Sikkim eastward to southern China, Hainan and Formosa and south to Sumatra, the Malay peninsula and Borneo[2], but according to Pocock (1939: 251-3) little is known of its habits. He describes it as 'everywhere rare, or at all events seldom seen by European sportsmen, probably because it inhabits dense forests and is nocturnal'. The only field notes to which he was able to refer appear to have been those of Raffles from Sumatra (1821: 250), Tickell from Sikkim (1843: 816), Swinhoe from Formosa (1862: 353) and Brownlow from Tavoy (1928: 789).

According to Raffles the animal is largely arboreal and preys on birds. Tickell says that in Sikkim it feeds on goats and pigs, that it is savage and wary, and that when wounded it may turn fiercely on its assailants. According to Swinhoe it commits great havoc among deer in Formosa; but he adds that it never attacks man unless provoked. Brownlow provides the only positive contradiction to the last statement at present recorded, a leopard which killed several head of cattle and then stalked a native boy, who saved himself by splitting its skull with his knife. For completeness one may perhaps add the account by Gabb (quoted by the editors in this journal, 48 (4), 1949: 804) of a pair found feeding on porcupines in a cave in the Darjeeling district. The information supplied with the skin from North Borneo adds several items to these data; in addition earlier notes have been published on *nebulosa* in Borneo which are apparently not available in India. It seems, therefore, to be of value to summarise this additional material for the benefit of readers of this journal.

The North Borneo specimen was a female; the ground colour of the skin is a dull grayish fawn, with the flank pattern in the form of well-marked rosettes, each with its anterior rim about as thick as the posterior rim. It was encountered in a coastal swamp at Ulu Sungei

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[1] The animal was killed on 19 March; it was sent to the Raffles Museum by Mr. G. S. Brown, Asst. Conservator of Forests, North Borneo.

[2] Pocock (*loc. cit.*) includes Java in the range of the Clouded Leopard; so do Carter, Hill & Tate, the authors of 'Mammals of the Pacific World' (1945 :96). Chasen (1940 :106) and Tate (1947 :191) rightly refrain from doing so. The error is one of some antiquity; it starts with G. Cuvier (1823 :437), who cites Java as the type locality of his *Felis diardi,* which is a race of *nebulosa.* To the best of my knowledge no feral specimen has ever been taken in Java. The Raffles Museum collection contains a fine beast said to have been killed at Changi, on Singapore Island, in 1898.

Kurapo, near Mumiang and about 18 miles east of Sandakan. It was accompanied by a second example, presumably the male, which is described as larger and coloured black and yellow, with the markings more or less circular on the back and incurved stripes on the flanks, 'like a circus tiger'.[1]

The animal was killed by Awang bin Jim, the Forest Guard stationed at Mumiang. According to his account he had landed from the Sungei Kurapo to accompany two other men who were gathering *lamiding*[2] vine for tying fish traps. The forest growth was mainly *nipah* palms (*Nipa frutescens* Wurmb.) towards its landward limit, in fresh water and associated with mangrove-dry-land marginal tree species. The party heard cries, and on investigating came upon a pair of leopards attacking a large male Proboscis Monkey, *Nasalis larvatus* (Wurmb.). The leopards had isolated it in a low leaning tree about 9 feet off the ground and were leaping at it. They dragged it down and killed it. Awang says that as they approached more closely the female turned to attack them, so they ran to their boat. There Awang had a shot gun, and he killed her with buckshot, shooting from the river. The time was about 3 p.m. They started to go ashore to get the carcase but the male made as if to attack them; so they went off some distance and collected dry *nipah* fronds which they used as a torch to scare it off.

Awang unfortunately did not measure the dead leopard before skinning it, and he threw the skinned body, including the skull, into the sea. He says that the body was so heavy that it was difficult for two men to lift it. He brought in the dried skin. Even in its shrunken condition it measured 5 ft. 4½ inches from the nose to the end of the tail. The accompanying photograph shows the beauty of the patterning.

There are several interesting points about this record, the habitat, the colouring of the two animals, the addition of yet another item to its known menu, and the fact that it provides a second account of an apparently unprovoked attack on man. Without doubt there must be a wide range of temperament in this species—at least as wide as its reported diet. Banks (1931: 77), writing mostly of the Sarawak region of Borneo, says that there its behaviour is exemplary 'as it is not recorded as molesting children or dogs, much less man.' Elsewhere (1949: 50) he describes it as on the whole sluggish, indolent, retiring and good-tempered. Harrisson (1949: 74) says it is always extremely shy; 'Nobody fears this huge cat, and there are derogatory stories about its prowess . . . . .'

Banks (1931) also describes the Clouded Leopard as a shy and retiring species, seldom seen and of unknown habits. He adds that

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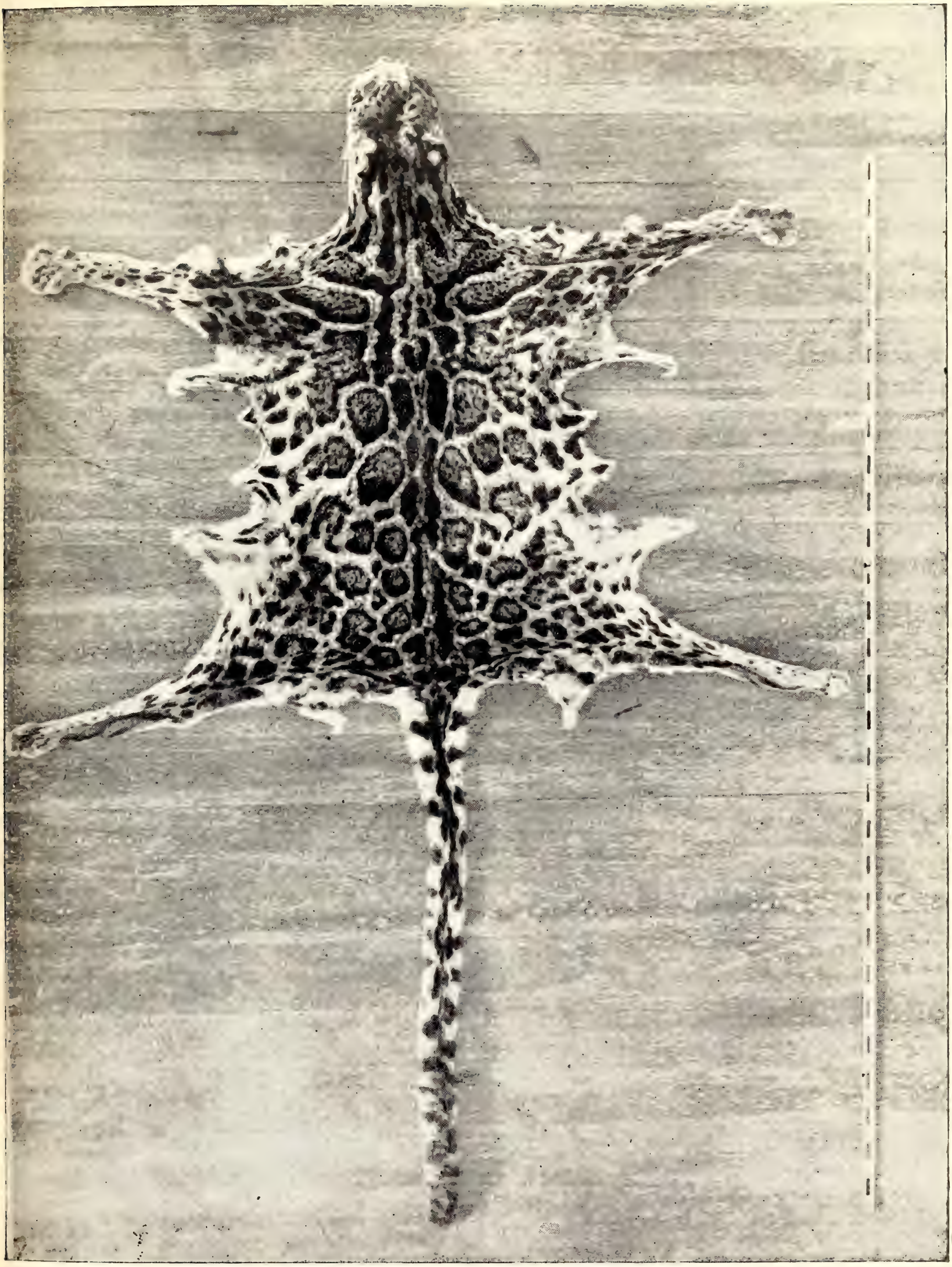
[1] There are no feral tigers in North Borneo, but a very successful circus, which included a Bengal tiger in its menagerie, visited Sandakan and Jesselton while I was in Borneo in July 1949. It may be remarked that the Leopard, *Panthera pardus* (Linn.), also is not known from Borneo, and the Clouded Leopard is thus the largest of the Felidae recorded from the island.

[2] Lamiding vine, a climbing fern, *Stenochlaena palustris* Bedd., found widely in tropical Asia, Malaysia and Polynesia. 'Lamiding' is the name usel in North Borneo by the Brunei, Malay and Suluk peoples there. In Malaya it is usually known as *akar paku* or *lembiding*. The stems are used for binding fish traps and sometimes for basket-making.



Skin of a female Clouded Leopard, *Neofelis nebulosa diardi* (G. Cuvier), shot in a coastal swamp area near Sandakan, North Borneo, on 19 March 1950.

the natives know little about it beyond the fact that it is almost entirely arboreal, though it is sometimes shot at night on river banks and very occasionally caught in snares on the ground. In Sarawak it is said to occur mostly in old jungle, but in some parts, such as the Lawas district, it is found in areas of *bĕlukar* or secondary scrub. Its corpse is much prized. The canine teeth are sought by Kayans, Kenyahs and others (but not by the Dayaks) for use as ear ornaments, the skin is employed for seating-mats and parts of the body are used by the Chinese for making medicines. As a result the Sarawak Museum was without a complete specimen until after the end of the war. Since then Harrisson (*loc. cit.*), the present curator, has obtained two skins, one from the interior of Dutch Borneo, and the second from an animal that was cornered by dogs in the Ulu Baram district of Sarawak early in 1947.

According to Banks (1949) its diet under natural conditions consists of pigs, in this case it would be the large *Sus barbatus* Müller, and monkeys, while it also follows buffaloes with calves. Earlier (1931) he says that it sometimes constructs a large nest of sticks in a tree top, and that it has been recorded sallying forth suddenly to take a Long-tailed Macaque, *Macaca irus* F. Cuv. A specimen which he subsequently had in captivity killed a large Pigtailed Macaque, *Macaca nemestrina* (Linn.). The latter is rather nearer to the size of the Proboscis Monkey, which the North Borneo leopards were attacking. The captive animal also took chickens, rats and squirrels, and would eat two fowls a day if allowed to do so. It would seem actually that there is no call to ridicule Raffles's statement that in Sumatra the Clouded Leopard takes birds and poultry, as Tickell and Pocock have done. The evidence certainly suggests that in Borneo it is partial to monkeys and pigs, and will take young buffaloes, all good, weighty, meaty items. Obviously when these are not immediately available it goes for smaller stuff in the same habitats. A tiger has been found with frogs in its belly, and immature Leopard Cats, *Felis bengalensis* Kerr, will certainly jump for grasshoppers, as domestic cats do. The only error is to assume that the small items represent the major meals, instead of snacks taken while waiting for something bigger to appear.

The last point about the North Borneo specimens is the question of colour and markings. The skin before me, with the well-determined rosette pattern on its flanks, is clearly an example of the Malaysian race, *diardi* G. Cuvier, 1823 (type locality probably Sumatra). Like the other available skins here from Borneo it is noticeably greyer and more heavily marked than the Peninsular specimens. In this it apparently resembles the type of *macrocelis* Temminck (in Horsfield, 1825; type locality Bencoolen, West Sumatra). On the other hand, if we are to believe the Forest Guard's description of the second leopard, which can only have been an example of *Neofelis nebulosa*, it was much nearer to animals of the typical race from Indo-China and southern China. Obviously only a very limited value can be placed on the characters of a skin that is still in the field, but it does at least suggest that the range of colour and pattern exhibited by *nebulosa* in Borneo is probably very wide. Harrisson (*in litt.*, 28: 4: 50) tells me that one of his Sarawak skins has the ground colour almost full yellow. At the other extreme both Banks (1931) and Harrisson (*loc. cit.*) give reports of melanistic forms, the one from Mount Matang, near Kuching, and the other from the interior of Sarawak. So far as I am aware melanistic examples have not been recorded from the range of typical *nebulosa*, but Jacobson (1921: 238) suggests that they occur also in Sumatra.

Finally, Pocock (*loc. cit.*) says that nothing appears to be known of the breeding habits of the Clouded Leopard. According to Banks (1949) it has two young to a litter. He describes them as very tame and playful, preferring meat to milk but never exhibiting the ferocity that soon manifests itself in young Leopard Cats. He also says that they chuckle, purr and growl. An adult, which he heard moving at night, emitted a mournful, but not very loud, call not unlike the howl of a dog or the moaning of the wind as it passes over the open mouth of a large jar.

RAFFLES MUSEUM,
SINGAPORE, 6.
27th May, 1950.

C. A. GIBSON-HILL

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6. THE STRANGE DEATH OF A BISON

In 1941 while I was preparing Working Plans in Panchnoi Block, Charduar Reserve in the Darrang district, Assam, a very interesting incident happened, which I am recording though it may sound unbelievable.

A field assistant with a batch of Naga labourers was doing enumeration work. All of a sudden a solitary bull bison appeared before him and all his labourers ran away. The only thing the field assistant can now remember is that he stood face to face with a bison who was ready to charge. He later told me that he (being a Muslim) just shouted the word 'Allah' and collapsed. He was carried to the camp in the evening by the labourers who told me that the bison was lying dead in the forest and the babu was miraculously saved.

Next morning I went to the spot and found a big bull bison lying dead with his fore-legs entangled in a big climber which hung between two large trees. The hat and enumeration book of the field assistant were just by the side of the bison's head. The only reconstruction I could make of the bison's death was, that while charging towards the field assistant the climber caught in his fore-legs causing him to fall on his head and break his neck. Death appears to have been instantaneous. The Naga labourers told me that they saw the bison facing the babu and they ran, and when they returned they found both the bison and the babu lying side by side!

The field assistant was not hurt at all though he did not recover from the shock for several days. He actually had high fever and was in a delirious state for a number of days. The Naga labourers ate the bison meat and brought the head to camp. The head was shown to the Conservator, when he visited the area later.

JORHAT,
ASSAM,
April 1950.

L. RYNJAH,
Asst. Conservator of Forests.

7. A DOE CHEETAL WITH HORNS

My cousin, Rajkumar Dharampal Singh of Awagarh, and I had jointly taken three blocks in South Bastar Division (Bastar State) for a month. We were encamped in the capital of Kutru Zamindari itself and decided to go out for a spin in our car. It was 5.30 p.m. in the evening and we had proceeded about ten miles on the Bijapur road, when we spotted a herd of five cheetal about 200 yards away. One among them seemed to carry a good pair of horns. As we stalked them, the herd receded further in, but the Rajkumar of Awagarh ultimately put in a long shot and bagged the cheetal with horns—the only one in the herd which carried a pair. On reaching the dead animal we found to our disappointment that the horns were not as big as expected and measured only 29½ inches. But scrutiny of the carcass revealed a very interesting fact. The male sex organs were missing, while the mammae along with all the female sex organs were present. I further cut open the cheetal, and found that it also had an ovary and all the other internal organs of a normal female. It was in fact a doe cheetal with horns measuring 29½ inches. The animal was shot in the Toyanar Block of Kutru Range in South Bastar Division near Gudma village. On hearing of my rare experience the local villagers informed me that some years back a Muria Gond had also killed a doe sambar with horns, but I cannot say how far this report is correct. I have, so far, met no sportsman who has ever told me of such an experience.

P. O. DHARAMJAYGARH,
VIA KHARSIA, B.N. RY.
29th June, 1950.

CHANDRA CHUR,
Raja Sahib of Udaipur State,
Madhya Pradesh.

8. THE OCCURRENCE OF ALBINO AND MELANIC RATS

Mr. Romer's account (1) of the apparently natural occurrence of a piebald white and natural coloured rat in Hong Kong raises the question of the frequency of the occurrence of albinism and melanism in nature.

Exact statistics of the occurrence of such aberrant forms may well prove of value to geneticists and students of evolutionary theory, but they are very hard to obtain. Black or white specimens of various animals are often recorded in the literature or find their way into collections, but visual observations are obviously biased by relative conspicuousness, and I know to my cost how often collectors select the unusual or extreme forms for skinning, to the detriment of estimates of relative abundance. It is likely however that many potentially valuable records are locked away in the notes or memories of workers whose business it is to make routine examinations of large numbers of animals.

When animals are collected not as specimens, but for destruction as pests, for bacteriological examination, and so on, the proportion of unusual specimens is likely to be truly representative of their natural frequency. I would appeal therefore to all those who have such information to publish it. A letter to this journal seems the appropriate medium.

Mr. Romer has kindly given me his figures, and I have extracted figures from unpublished records collected in Rangoon (2) and in Malaya. Negative evidence is often of as much value as positive, and so I have included rats of which no aberrations were observed, but only of those species of which several hundred have been seen. The records in the following table refer only to cases of melanism and albinism in rats.

TABLE

Species	Number examined	Aberrations
1. Data from J. D. Romer, Hong Kong, 1948 and 1949		
Rattus norvegicus	328,400	1 piebald albino-normal, 1 other 'white rat' (*? R. norvegicus*) reported, but latter a doubtful record. Melanic specimens fairly frequent but numbers not recorded.
2. Unpublished data from Harrison and Woodville, Rangoon, 1945		
Bandicota bengalensis	800	10 black 1 with a ventral white patch
R. exulans concolor	1,200	none
3. Scrub Typhus Research Unit records, Selangor Malaya, 1948 and 1949		
R. rattus diardi	3,717	no complete melanic or albino forms, but this rat is very variable and white or near white patches on the belly are frequent.
R. rattus jalorensis	863	none
R. exulans concolor	237	none

Species	Number examined	Aberrations
R. mülleri	171	none
R. rajah	135	none
R. sabanus	273	1 albino, fur uniform pale grey almost white, eyes and tail dark.

KUALA LUMPUR,
MALAYA.
10*th March* 1950.

J. L. HARRISON,
M.SC.

REFERENCES

1. Romer J. D. (1949): Naturally occurring albinism in a specimen of *Rattus norvegicus* Berk. *J. Bombay Nat. Hist. Soc.*, **48** : 579.

2. Harrison J. L. and Woodville H. C. (1948): An attempt to control house rats in Rangoon *Trans. R. Soc., trop. Med. Hyg.* **42** : 247-58.

9. 'SOORI PHANDA'

Commenting on Shri S. R. Daver's interesting article on the Soori Phanda method of killing tigers, Lt.-Col. R. W. Burton refers (p. 65 of Vol. 49) to the use of a spiked bamboo method in the 'Triangle' of Myitkyina district, Burma.

I showed the sketch of the Soori Phanda to my Kachin orderly, who comes from Nawngkai village 13 miles south-east of Fort Hertz, and he at once said that the Kachins of his tract, which can loosely be described as constituting the northern extremity of the 'Triangle', use almost identically the same method; normally bamboo spikes alone are used, without an iron spear-head at the tip.

If two trees are not readily available the Kachins tie the carcase on top of two poles which are then propped up in such a way that a tug at the carcase pulls away the prop; as the poles (which are about 2 feet apart) come crashing down the bamboo spikes come up between them and impale the tiger.

Lt.-Col. Burton goes on to say that the tiger is 'not particularly harmful to the human beings of those parts'. Tigers are in the habit of taking cattle, ponies, goats, sheep (brought over from the Nam Tamai) and pigs; in 1947 ten heads of cattle were taken from my orderly's village, a heavy loss for one small community. Man-eaters are not unknown. The flesh of the tiger is eaten (though not relished except by the Lisus) and the bones used to fetch 10 to 20 rupees a viss by sale to the local Chinaman. It is not surprising therefore that the Kachins do their best to destroy tigers.

'Hpalok makam' is the Kachin name for a Soori Phanda, and 'Masun' corresponds to 'Soori'.

DIVISIONAL FOREST OFFICER,
SIBU SARAWAK,
16*th June,* 1950.

B. E. SMYTHIES

10. LARGE GREY BABBLER ATTACKING METAL HUB-CAP OF WHEEL OF CAR

On 2nd January, 1950, I was sitting in the garden at Delhi, the car standing in front of the porch not many yards away, when I heard a sound as of something striking metal. I saw that a Large Grey Babbler (*Argya malcolmi*) was jumping from the ground and vigorously tapping the metal hub-cap of the wheel of the car. A servant came to see what was causing the noise, and thereupon the bird went round to the wheel on the other side, but again it was driven away. Soon after the car was driven away for half an hour, but then was left in the same position.

Presently the babbler reappeared, and as no servant was within hearing, for some two minutes the bird constantly leapt up, and made a resounding peck at the hub-cap each time.

When it finally grew tired of this extraordinary action, I went to the car, and by lying on the ground tried to get my eye into the position of the babbler's eye. It was true that I could see myself reflected in the cap, but, owing to its convex shape, my image was greatly reduced in size. This makes the behaviour of the bird all the more puzzling.

In England there have been records of Grey Wagtails (*Motacilla cinerea*) constantly tapping at windows, and occasionally I think other species have been noted. It is usually supposed, I believe, that the bird sees its own image reflected in the window, and tries to attack it. But why should a bird try to attack its own image when that image looks very small and therefore presumably a long way off? Moreover, the Large Grey Babbler is notoriously a sociable bird, and in this very case, others of the 'sisters' were hopping about quite near, although no other indulged in this curious action while I was watching. I am almost inclined to think that the noise had more significance for the bird than the image seen in the hub-cap. Can any of your readers provide any parallel experience?

24, Rajpur Road,
Delhi,
1st June, 1950.

H. G. ALEXANDER

11. COMMON MYNAH (*ACRIDOTHERES TRISTIS*) NESTING IN THE NEST OF PIED MYNAH (*STURNOPASTOR CONTRA*)

A pair of Pied Mynahs had built their nest in the lower branches of a sal (*Shorea robusta*) at a height of about 25 feet from the ground, in my compound here in Giridih. When the nest was complete the rightful owners were set upon and driven away by a pair of Common Mynahs, who have now established themselves in the nest.

Referring to Stuart Baker, Fauna, Birds, Vol. III (2nd ed.) page 54—I see that he has seen a few nests of the Common Mynah (*A. t. tristis*) built in trees and that the nests were 'huge domed affairs like those of the Pied Mynah.'

Could it be possible that the nests he saw were not actually *built* by the Common Mynah but were stolen property as is this nest in my compound?

c/o D. E. Rosair, Esq.,
P.O. Giridih, K. M. KIRKPATRICK
Dist. Hazaribagh, Bihar.
23rd June, 1950.

[In Vol. II, p. 526 of his 'Nidification of Birds of the Indian Empire' Stuart Baker writes of the Common Myna :

> "When they make their nests on branches of trees they are rather better built. All those I have seen myself were domed, great balls of grass, leaves and miscellaneous scraps, with dense linings of feathers. Other writers, however, speak of cup-shaped nests. Tickell and Hume both saw such nests ; Adam 'saw a pair of this species building a large cup-shaped nest in a babool-tree' ; while Marshall (G.F.L.) says that this myna 'frequently lays in cup-shaped nests of sticks placed in trees, like small crows' nests'."—Eds.]

12. PECULIAR ROOSTING SITE OF THE HOUSE SWIFT (*MICROPUS AFFINIS*)

During a recent rainy spell here my servant, an aboriginal of no mean observationary powers and a keen bird-watcher to boot, informed me that he had seen quite a few House Swifts, which are very common here, flying into the nests of the Baya Weaver (*Ploceus philippinus*)—a colony of which were then breeding in a Palmyra (*Borassus flabelliformis*) in a garden nearby. As I had previously noted that this particular palmyra was also the breeding haunt of the Palm Swift (*Cypsiurus parvus*) I thought he may have made a mistake and accordingly proceeded to investigate.

However, I am glad to say that his observations were quite correct and that at least ten or twelve House Swifts were utilising old but sound nests of *P. philippinus* as dormitories during the rainy spell but deserted them as soon as the weather returned to normal. The weaver birds were breeding at the same time in the same tree but did not apparently mind this 'squatting' in their former homes.

The House Swifts, so amazingly agile on the wing, could not compete with the Bayas in ascending the funnel of the nests in one aerial zoom but contented themselves with alighting on the inside of the funnel about two or three inches up and then very laboriously crept up the rest of the way. That they were not breeding in the Bayas' nests is apparent from the way they so readily deserted them in fine weather and also by virtue of the fact that at least three to four birds were occupying a single nest.

Total nests on the tree were as follows:

1.	*Ploceus philippinus* (in active use and green)	14
2.	,, ,, (old but sound and used at random by *Micropus affinis* as dormitories)	5
3.	*Ploceus philippinus* 'Cocknests'	6
4.	*Cypsiurus parvus*	4
5.	*Acridotheres tristis* in leaf base	1

It may also be interesting to note that the Baya in Giridih frequently hangs its nests in small colonies on the imported Eucalyptus, which grows well in this climate and the fruit of which is a great attraction to swarms of flying foxes in season.

GIRIDIH,
28th September, 1950.

KENNETH M. KIRKPATRICK

13. TAMENESS OF WILD GREY LAG GEESE TAKEN AS ADULTS

When we were camping at Katoria in March, 1949, (South Bhagalpur District), the Excise Sub-inspector came to meet us followed by a pair of Grey Lag Geese (*Anser anser*). As these were obviously wild birds and not the common village geese, my interest was aroused. On enquiry it came out that both the birds had been shot the preceding February at a tank situated about 1½ miles from the Dak Bungalow in the middle of some scrub forest. It is a biggish tank, the largest stretch of water for some distance, and with a good deal of cultivation near about.

The female was shot on 6-2-'49, at about 5 p.m., in the right wing which was badly damaged. The local doctor successfully amputated that wing and the goose lived. It was a remarkable case of surgery meant for human beings applied to a bird.

The male was shot on 19-2-'49, in the wing at about 5 p.m., and recovered after treatment by the same doctor.

Both are perfectly tame now. The female is incapable of flight, but the male occasionally takes to the air, always returning, however, to the house of its owner. They are fed on paddy and boiled rice.

I wonder if cases have occurred of wild geese having been shot and subsequently domesticated.

c/o SAMI AHMED ESQ.,
FOREST OFFICE,
DALTONGANJ,
3rd April, 1950.

JAMAL ARA

14. STRAY BIRD NOTES FROM MALABAR

1. The Stork-Billed Kingfisher. This bird though reputed shy, is a conspicuous resident in many villages in Palghat taluk. Even in the heart of the town its calls are often heard during the rainy season. In the drier months of the year it goes about singly and is somewhat retiring by disposition, but when the rains break, it is found in pairs and flies about boldly filling the air with its loud raucous calls.

In the months of May, June, July and August, the Storkbilled Kingfisher indulges in a strange sort of game. Both birds of a pair sit on some low perch, a short distance away from a mud or brick wall that has neither been plastered nor whitewashed, and uttering the harshest of their calls, dart with breath-taking speed at the small holes or cracks in the wall as if to transfix the wall with their bills. Some times they hit it with such force that an onlooker would expect their bills to break. Yet nothing happens, the birds return to the perch, flick their tails and bob up and down (as the Common Kingfisher does after it has swallowed a fish) and once again without waiting even to wipe off the mud sticking to their bills, fling themselves at the wall, to the accompaniment of fiendish croaks.

One of the walls, on which a pair used to concentrate, had a long narrow crack running down it. In five different places along this the Kingfishers had made small cavities 3 to 4 inches across and 4 or 5 inches deep by flying repeatedly to the same points. None of the holes was excavated further and, after a time, the birds lost all interest in them.

The zeal with which the birds play this 'game' decreases as the rainy season advances; in May and June the kingfishers spend five to six hours at it, whereas, in late August, they fly only once or twice a day at the walls. By the end of July the birds begin to go about singly. It is clear that they take the greatest interest in the walls when they are together, and become indifferent when, or soon after, the pairs break up.

The birds do not seem to have any obvious motive for doing this. Though geckos and some insects like the mole-cricket often hide in the crevices, the kingfishers have never been found catching and eating any.

The White-breasted Kingfisher, while making a tunnel, often does the same sort of thing in a mud bank. But the Storkbill cannot nest in hard, three-foot thick brick walls. As the birds make these small holes year after year, unless we assume that they never learn from experience, we cannot say that they are attempting to nest in the walls.

Is this then a sort of courtship? Or is it just a game the birds play with the sole purpose of letting off steam during the early part of the breeding season? (Though I have yet to find a nest of the Storkbill, I have little doubt that their breeding season here is in the monsoon months.) The Common Kingfisher's courtship consists of, or at least begins with, a mad chase during which the pursuing partner utters high-pitched, piercing whistles. In May and June, the Storkbilled Kingfisher also frequently chases its mate, less speedily than its smaller cousin, but with much more noise. And as it is at this period that the birds spend most time near the walls, I suspect that this wall-boring may be a part of the courtship activities.

2. THE PARIAH KITE—Local Migration? From the village of Kavasseri, 12 to 13 miles south-west of Palghat, Pariah Kites totally disappear during the monsoon months, though in Palghat town itself they may be seen even at the peak of the monsoon.

On 29th May, 1950, some days after the rains had set in, I was surprised to find some twelve Pariah Kites sailing and soaring like vultures from south to north (or north-east), late in the evening, along a range of hillocks. The next evening not even a single Pariah Kite was seen in the place though I kept close watch. On the 31st, at about 8.30 a.m., I was standing on top of a hillock, one of a line extending roughly east to west for some miles, stretching upto the Palghat Gap on its southern side. There was a strong wind blowing from west to east and a light shower of rain also. My attention was caught by seven Pariah Kites that seemed to be sailing single file against the wind, towards a point in the west. These were very soon followed by a surprising number of Pariah Kites, flying along the same route, over some valleys and low hillocks which lay in a line, east to west. In twenty minutes more than two hundred birds flew past. Some alighted on a low gravel covered hillock, the only low hill which was not all rock. There were many small boulders on this hillock. On these many of the birds sat, some alighted on the bare ground and others waddled about clumsily holding their wings horizontally extended. Often two or three quarrelled for the same stone to perch upon.

Apparently they alighted on the hillock for a brief rest. As some of these took off and continued their journey, others, coming from the east, took their places. Almost all the birds sailed down on steady wings and only two or three strayed, soaring about over some spot on the way. The birds never uttered any calls. By about 9.30 a.m. all the birds had disappeared, though a few still dribbled in in ones and twos. Two or three left the main line of flight and were seen at 10 a.m. wheeling about over a village half a mile to the north. On June 2nd I went at 8.30 a.m. to the same hillock, but not a single Pariah Kite was seen though I remained till 10 a.m. Thirteen or fourteen Brahminy Kites flew west along the same route which the Pariah Kites had taken. The village of Kavasseri lies in a sort of cup within the hills: on the eastern side we have the Palghat Gap, and on the western side there is a small break, a valley, east of Trichur. The Kites seemed to be headed straight towards this. I wonder whether this was a local migration. Normally Pariah Kites are never seen in such large numbers in the place at any time of the year.

3. THE LITTLE MINIVET. THREE ADULTS WORKING AT THE SAME NEST. On the 9th of April, 1950, I came across a nest of the Little Minivet in a teak jungle on the lower slope of a hillock. While watching the birds at work, I was surprised to find *three* birds sharing the labour! One was a male and the other two, apparently, were females. All three came repeatedly to the nest and evinced considerable interest in its progress. One after the other they came to the

nest, their wings feverishly quivering, added some material to the nest, and waited until the others had also done the same. Of the two which were in female plumage, one was definitely more active, came to the nest more often and more regularly and seemed to get more attention from the male. The less active female, however, brought lichen or cobweb now and then and worked it in as efficiently as the other two. About a month later[1] when the two chicks were being fed, all three adult birds were in attendance and all fed the chicks ! How did three birds come to share a nest? Was the third another female—one that had not begun to lay, or having laid, had lost its eggs at a late stage,—or a chick of a previous brood? Has this kind of thing been observed in the minivets or any other birds before?

GOVT. VICTORIA COLLEGE,
PALGHAT, S. MALABAR, K. K. NEELAKANTAN,
6th September, 1950. B.A. (Hons.)

15. STRAY BIRD NOTES FROM TIBET

In a letter dated 12 April 1950 from Lhasa, Mr. H. R. Richardson of the Indian Political Mission gives some interesting ornithological information.

'The spring always brings a pair of Goshawks (*Astur gentilis*). There are also the Hobby (*Falco subbuteo*), Sparrow-Hawk (*Accipiter nisus*), Cherrug and Laggar Falcons (*F. cherrug* and *F. jugger*) and the Peregrine (*F. peregrinus*), although not actually at Lhasa.

I have seen Avocets (*Recurvirostra avocetta*) in large numbers, also Black-tailed Godwit (*Limosa limosa*) and a Stilt (*Himantopus himantopus*) on the Hram Tsho.

This year I saw a Kingfisher (*Alcedo atthis*) at about 13,600 feet in November sitting quite happily on a block of ice above Samada. Another point, on which Ludlow[2] had doubts is the occurrence of the White-capped Redstart (*Chaimarrhornis leucocephalus*) beyond the Tang La. It is common round Lhasa in the summer and I have seen it in Yarlung and also some 60 miles north of Lhasa. The Blue-fronted Redstart (*Phoenicurus frontalis*) also occurs round Lhasa.

Once and once only, I have seen a Rosy Pastor (*Pastor roseus*) at Lhasa; it must have been a wanderer'.

114, APOLLO STREET,
FORT, BOMBAY. EDITORS
20th May, 1950.

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[1] During this interval I was away from the village and could not continue my observations.

[2] Birds of the Gyantse Neighbourhood. *Ibis* (1928 :60).

16. SCENT OF GAME-BIRDS

Do game-birds lose their scent in the breeding season, as a provision of nature, or develop an obnoxious counter scent?

A young friend staying with me, committed the unforgivable sin of shooting a stone-curlew (*Burhinus oedicnemus*), better known as the goggle-eyed plover, in June, when both my seasoned and trained labrador, and a puppy under training 9 months old, refused to pick it up.

The dog is four years old and has retrieved snipe and woodcock and all the common game-birds met with in a season's shooting; the puppy retrieved snipe and teal at five months, but even when I persuaded her to carry the bird, she held it gently by the neck and her expression was definitely one of disapproval.

I have read of these birds being excellent for the table, but have never myself shot or eaten them before, and when I tried to eat this bird it tasted like a pigeon boiled in quinine! To satisfy my curiosity I had two others shot in the same locality (there are about thirty birds collected and some have already flown their young, while others have eggs on which they are sitting). The birds shot were males, and all tasted rank.

Will the pundits give an explanation?

KOOREA,
P. O. BETTIAH,
CHAMPARAN, BIHAR,
6th July, 1950.

A. ST. J. MACDONALD

[Dr. Hugh B. Cott of the Cambridge University Zoological Museum—who has done (and is doing) some excellent pioneering investigations on the palatability of birds and their eggs in relation to conspicuous and cryptic colouration—in a recent letter quotes a number of well-authenticated examples confirming that ground nesting birds lose their scent in the breeding season as a protection against predators that 'follow their nose'.

What interests Dr. Cott particularly in our correspondent's note, however, is the suggestion, new to him, that breeding ground-birds may not merely lose their scent in a passive way, but may on the other hand actually develop an obnoxious scent (and taste) that might act as a deterrent to enemies. This is what would appear to have happened in the case of Mr. Macdonald's stone-curlews, a species which consensus of opinion of most sportsmen in India and elsewhere (and also our own experience) pronounces to be excellent eating in the non-breeding season—at least in winter.

The suggestion obviously offers a wide scope for serious experimental and observational work in which sportsmen and field naturalists can make useful contributions to knowledge. Dr. Cott suggests making comparisons as regards flavour in some Indian birds, both in and out of the breeding season, selecting for the experiments ground-nesting and cryptic species, such as, for example, Grey Partridge, Common Sandgrouse, Courser, larks, and pipits. The flesh could be tasted in different seasons and ranked by a system of percentage deviation from a standard, by a panel of selected human tasters. Or it could be offered to a discriminating dog or cat together with some standard food to afford a means of comparison. Both these methods are successfully employed by Dr. Cott for his own investigations, and it is amazing how closely the results agree with and complement each other.—Eds.]

17. FIELD IDENTIFICATION OF BIRDS: NOTES ON THE HOODWINK (*DISSIMULATRIX SPURIA*)

After conversations with many bird-lovers, glances at my own ornithological notebooks and perusal of articles in ornithological journals, I am impressed by the number of records of birds partially seen or indeterminately heard: and it seems evident that the majority of these records are attributable to a single species—the Hoodwink—which I propose to name *Dissimulatrix spuria.*

The existence of this species has already been recognised by several authors, amongst them James Thurber, who has presented a somewhat imaginative picture of the bird perched upon a spray of Ragamuffin. Gaetke, on Heligoland, shot several specimens of the Hoodwink, but they invariably fell over steep cliffs into the sea and 'were not secured'. Observers in tropical forests are familiar with the Hoodwink, which invariably keeps to the densest vegetation (where it is extremely vociferous), and refuses to be lured into the open by the observer's imitation of a Black Mamba. The Hoodwink has several times been photographed: it is the brown blur that passes rapidly from right to left in all ornithological films. In many records of bird song, also, the Hoodwink can be heard in the background, imitating the barking of dogs, the hooting of automobiles, the pleasant drone of the farm tractor, etc. The Hoodwink was known to the Ancients: unsatisfactory views of the Hoodwink, before the invention of the telescope, led to unreliable early records of the Phoenix, Roc, Harpy, Hippogriff, Barnacle Goose, etc. Nor has the Hoodwink been neglected in literature: it is clear to the experienced observer that both Keats and Shelley wrote Odes to the Hoodwink. The bird has also a definite place in British folklore; in parts of East Anglia it is, to this day, considered lucky to drink a gallon of beer both before and after first hearing the Hoodwink in spring.

A peculiarity of the Hoodwink is that it is more frequently observed by beginners in ornithology than by more practised observers. Yet records by practised observers exist. In a recent number of the *Ibis* a well-known ornithologist, in order to demonstrate the fatuity of 'sight records,' related how he had seen a Common Buzzard identified by a German zoologist as a White-tailed Eagle. Now, according to the evidence to hand, there is no presumption that it was a buzzard rather than an eagle. Surely a third hypothesis is possible—that it was a Hoodwink. And readers of ornithological literature in the 1930s will remember the case of the Hoodwink on one of the London reservoirs which imitated now the Great Northern Diver now the Black-throated.

Only one record of a ringed Hoodwink exists: on being ringed, at Tooting Bec, it was entered in the schedule by the Misses Motmot and Tody as 'Little Tom Tit' and was subsequently recorded as 'Blue Tit, imm.' On being retrapped, it was thought by Miss Eleanora Falcon (of Woking), after reference to the *Handbook,* to be a Lanceolated Warbler. It was later found dead, in an advanced state of decomposition, and identified by Mrs. Snow-Bunting, also of Tooting, as her Budgerigar *Melopsittacus undulatus,* Percy.

Below is listed what information has so far been obtained relating to the bird:—

The Hoodwink—*Dissimulatrix spuria* spec. nov. (Restricted typical locality, 'Mon Repos,' Waterloo Boulevard, Bournemouth.)

Habitat.—Catholic, with marked preference for suburban bird-tables. Frequently haunts cliffs, tropical forests, beds of ragamuffin (Thurber) and other places where quick dash to cover is possible. In Southern France in winter often found in loose association with other Hoodwinks.

Field Characters and General Habits.—Generally recognisable by *blurred appearance* and extremely rapid flight away from observer. Polymorphous and strongly imitative: when imitating another species closely similar to an allied species, will tend to imitate the rarer, i.e. Greenish rather than Willow Warbler, Collared rather than Pied Flycatcher, Blue-spotted Whitethroat rather than White-spotted Bluethroat, etc. *Usually solitary*: but Miss Florence Pratincole records *a flock of Hoodwinks,* seen many years ago near childhood home at Budleigh Salterton: Col. Trumpeter-Swan, uncle of observer, who had lived many years in India, insisted categorically that they were Hoodwinks. Most information on field characters obtained from bird-tables by Committee of Suburban Bird-lovers: 'a brownish silent bird, which jumped up and down all the time' (Miss Ruby Godwit, Murrayfield). 'I could not see whether it was as big as a thrush, but it seemed to fancy cold porridge' (Miss Betsy Phalarope, Auchenshuggle). 'About the size of a piece of wood' (Mrs. Carolina Craik, Epping). P. B. Shelley's observation that Hoodwink resembles 'poet hidden in the light of thought' not confirmed by later observers. Ordinary gait a rapid scuffle: in breeding season 'a stealthy walk' (Turnstone, *Fun in Birdland*). On water dives readily: average of 373 dives approx. 30 minutes—in each case the observer went home to tea before the Hoodwink had risen to the surface. Apparently roosts among rows of bottles *in bitternlike posture.*

Voice.—Usual call a shrill, slightly sibilant, 'pee-pee-wee,' perhaps the same as that rendered by Slobeend as 'wee-pee-pee.' Also utters 'a long-drawn wheezing sigh' (Wigeon *in litt.*), perhaps identical with the 'protracted sighing wheeze' described by R. C. Pochard. Call resembling the creaking of an unoiled hinge, formerly supposed to be uttered by Hoodwinks, now shown to be made by the creaking of an unoiled hinge. Also highly imitative, e.g. of Redwing, a sound commonly produced on October evenings, when ornithologists are listening for Redwings. In February and early March utters a loud, ringing 'cuckoo' (Daily Press, *passim*). *Song Period.*—Prolonged research involving rising at dawn, stop-watches and B.Sc. degrees have conclusively shown that the Hoodwink does not sing all the day long: sometimes it sings, sometimes it is silent. It has been suggested that Scottish Hoodwinks, on physiological grounds, should be separated as *D. s. annielaurieae* on account of prolonged singing on 31 December—described by McSporran as 'supersong.' The Scottish form does not, apparently, sing on Sundays (*v* histogram in possession of Ecclefechan Burns Club).

Display and Posturing.—In breeding season male flies round in ever-decreasing circles, evoking no response whatsoever from female. Also indulges in 'false preening,' 'false sleeping,' 'false waking,'[1] 'false eating,' 'false drinking,' 'false singing' and 'false dancing'; and, in the case of the female, a rapid movement of the toes denominated by Steinwaelzer 'false knitting' (*pseudotricotage*). 'Distraction display' takes the form of 'rodent-running'—only backwards: this causes female observers to run away, screaming (see Y. B. Sapsucker, The Distraction Display of the Female Ornithoscoper).

Breeding.—Details little known, but undoubtedly sometimes reproduces by *binary fission;* many reliable ornithologists, watching the Hoodwink, have seen it split into two halves and fly away in opposite directions. *Nest.*—Uses old mares' nests; eggs also laid at random, e.g. in egg-cups. Apparently responsible for the construction of *old nests,* involving young oologists in climbing *very high trees* or *very steep cliffs*: these nests often found to contain old baked-bean tins. *Eggs.*—Served in British hotels—recognisable by glycerine-like consistency and frequent presence of embryo. Also possibly in Egypt, where eggs described as tasting 'as if laid by mummy' (Lord Edward Cecil). *Clutch-size.*—Unknown, but, on approach of ornithologist, Hoodwink usually lays more eggs, or removes those already laid.

Food.—Analysis of two stomachs reveals 80 per cent vegetable food (pipe-cleaners and breakfast cereals[2]), but has been seen to pursue and kill a male Nitwit. Also recorded, shoots and seeds of *Lex nonscripta, Copia verborum, Lapsus calami* and *Insania amabilis.* McSporran considers that haggises are the pellets of the Hoodwink.

Distribution.—British Isles.—Sporadic: number of records depends more on character of observer than on frequency of species. Miss Fanny Pine-Grosbeak (Chorlton-cum-Hardy) has more than 322 records. Miss Euphemia Wryneck accurately refers to the status of the Hoodwink in Birmingham as 'pretty casual.' Interesting population studies of the Hoodwink have been made, using 'transects' taken from railway trains and nocturnal counts from lighthouses (Goosander and Smew. *Zeitschrift für mittelrutlandische Ornithologie,* Vol. CCLI).

Migrations.—Apparently aimless movements. British Hoodwinks move in a rough circle involving Fair Isle, the Isle of May, Holy Island, Spurn Point, Cley-next-the-Sea (Norfolk), the Norfolk Broads, Romney

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[1] A form of distraction display also recorded among university students.

[2] McSporran considers breakfast cereals to be *mineral.*

Marsh, the London Reservoirs, the Severn Estuary, Skokholm and the breeding quarters of the Kite (a Welsh village called Hush)—with occasional trips to the Camargue.

Distribution abroad.—Almost ubiquitous; coinciding remarkably with the distribution of the Fervent Ornithoscoper *Ornithoscopa perfervens,* on which it is partially parasitic.

Description.—Little known, although in the opinion of Elliott (*in oratione recta*) is not infrequent in museum collections, many skins becoming 'hoodwinked.' Brown speculum characteristic of third year female, though this is often obscured. General plumage, buffish fawn shading to fawnish buff. *Soft parts* (i.e. hard parts): fawnish horn shading to hornish fawn.

Characters and allied forms.—Immediately recognizable by the fact that the true basipterygoid processes are absent, but more anteriorly the basisphenoid rostrum bears a pair of facets projecting only slightly beyond its general surface, the so-called secondary basipterygoid processes, with which the anterior ends of the pterygoids articulate. Represented in Arctic snowstorms by *D.s. spurissima* (the so-called Pomatorhine Hoodwink), characterised by its more woolly appearance. *D.s. sarah-janae* (O.Hebrides), *D.s. mrs-jonesae* (Mull) and *D.s. gretae-garbo* (Clerkenwell) are doubtfully separable[1]. Bones of a closely related genus, *Palaeodissimulatrix,* have been found in kitchen middens.

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(Reprinted from 'Bird Notes', Vol. xxiv (3), 1950 with the kind permission of the editor and the author.)

18. THE RECORD RUSSELL'S VIPER [*VIPERA RUSSELLI* (SHAW)]

Up to the present date the largest recorded Russell's Viper measured 5 ft. 6 inches. That specimen was killed at Cuddalore, North Arcot, in 1894—(*Journal,* Vol. VIII No. 4. p. 565.) and was mentioned by Wall at page 3 of Vol. XVIII No. 2 as the largest record known to him.

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[1] This has not prevented the author of these names, in a laudable desire to immortalize various respectable females, from attempting to separate them until they have become extinct. This process has been termed 'going into a cline.'

The Russell's Viper shown in the accompanying photograph[1] was killed on 20th September 1948 on the Attikunna Estate, Nilgiris, elevation 3,200 ft. It was measured by W. T. Broadhurst to be 6 ft. and ½ an inch long, and the pole held by one of the men in the photograph was cut to the exact length of the snake. This photograph and the particulars concerning it are given to me by Mr. W. T. Broadhurst of the Jessie Estate, Malabar.

BANGALORE, R. W. BURTON,
2nd June, 1950. *Lt.-Col.* I.A. (Retd.)

19. A DHAMAN OR RAT-SNAKE [*PTYAS MUCOSUS* (LINN.)] JUMPING

On our way to the Caves on 25th June (Kanheri National Park) we startled a 6 ft. Dhaman which climbed up an adjacent bamboo, and laid itself on a horizontal branch at a height of about 18 ft. from the ground.

The snake was watched in this position for about 10 minutes while it lay motionless. A stone was then flung at it and this resulted in the snake jumping from its position on to the ground where it landed with a heavy thud and disappeared into a bush.

114, APOLLO STREET,
BOMBAY, V. K. CHARI,
20th July, 1950. *Asst. Curator*

[This is interesting and, if a common habit, may possibly provide the core of the frequent stories one hears in India about 'flying' snakes.—EDS.]

20. THE RECORD HAMADRYAD OR KING COBRA [*NAJA HANNAH* (CANTOR)] AND LENGTHS & WEIGHTS OF LARGE SPECIMENS

In his authoritative article on the Hamadryad in the Society's *Journal,* (Vol. xxx. pp. 189-195) Colonel F. Wall gave the length of the largest authentic specimen known to him as 15 ft. 5 inches.

In his contribution 'Early Days in Malaya', (Vol. 38, p. 257) the late Mr. H. E. Burgess mentioned a specimen 16 ft. 5¼ inches long.

A letter published in *The Field* of 23rd October 1948 Mr. C. A. Gibson-Hill of the Raffles Museum, Singapore, records a specimen taken alive near Fort Dickson, Negri Sembilan, which was kept in captivity for some time by Mr. J. Leonard of Ruthken Estate and later sent to the London Zoo, where it died. It measured at death 18 ft. 2 inches.

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[1] The photo is not clear enough for reproduction. EDS.

A recent enquiry to Singapore found Mr. Gibson-Hill away on leave, but a letter from the Museum Director informs me that the Aagaard's Nakon Sritamarat Mountains (Peninsular Siam) specimen of 18 ft. 4 inches, which is quoted by Malcolm Smith (Fauna of British India, Serpentes, 1943, p. 438.) may be accepted as the world's record for the Hamadryad.

The Director's letter mentions that quite recently a big hamadryad was killed on Singapore Island and brought to the Museum. It was 15 ft. 7 inches long and weighted 26½ lbs. It was very stout, so contrasts remarkably with Ditmar's ('Snakes of the World') record of 16 lbs. for a specimen of 15 ft., which, however, had been in captivity. That would account for the contrast in weight. A plaster mould has been made of this recent Singapore specimen.

BANGALORE, R. W. BURTON,
1st August, 1950. *Lt.-Col.* I.A. (Retd.)

21. BREEDING OF THE GOURAMI [*OSPHRONEMUS GORAMY* (LACEPEDE)] IN INDIAN RIVERS[1]

The Gourami is considered to be one of the best freshwater table-fish in the world. It is extensively cultured in Java and the other islands in the Malay Archipelago, from where it has been taken to Europe, Australia, Philippines and Ceylon. It was first imported to Madras from Mauritius in 1866 by Dr. Francis Day, and cultivated in the Government House ponds at Guindy and Madras and also stocked in the waters in and around Madras City. But as most of the stock was depleted by 1915, a fresh consignment was brought from Java by Mr. H. C. Wilson in 1916. The fish is now largely cultivated in the Government fish farms; and breeders and young ones are being distributed to pond-owners in the province. The fish has also been supplied to other States like Baroda, Bengal, Cochin, Hyderabad, Mysore, Punjab, Rajputana and Travancore, where it is reported to be thriving well.

The bionomics and cultural value of Gourami under Indian conditions have been observed by several workers like Raj[9],[10], Jones[5], Kulkarni[7],[8], Amirthalingam[1], Bhimachar *et al*[2], Spurgeon[12],[13] and Chacko and Venkatraman[3]. Attempts made by the Madras Fisheries Department since 2nd April 1940 by stocking 106 fingerlings in the Mettur Reservoir have succeeded in acclimatising the fish in the Cauvery river system. The fish is now fairly common in the thirty mile stretch of the river between Mettur and Bhavani, breeding in selected pools having macrophytic vegetation. It is also often captured and sold in markets by the local fishermen. Though Gourami inhabits the rivers of other inter-tropical countries, as reported by Willey[15], Weber and Beaufort[14], Jordan[6], Herre and Myers[4] and Smith[17], this is the first instance of successful establishment of the fish in a river in India; and augurs well for the addition of this valuable exotic species to our fluvial fisheries. The Tungabhadra river has recently been stocked with Gourami; and its growth is being watched with interest.

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[1] Communicated with the kind permission of the Director of Fisheries, Madras.

FRESHWATER BIOLOGICAL STATION,
KILPAUK, MADRAS,
February 1950.
P. I. CHACKO
A. R. K. ZOBAIRI

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22. FISH AND BAROMETRIC PRESSURE

Mr. E. P. Gee's note on the response of fish to atmospheric conditions reminds me of an incident that left us puzzled and surprised and to which there appeared to be no reasonable explanation. I am sorry that I have not retained any notes and this is from memory.

We were in a boat at the north end of Powai Lake near Bombay, looking for birds' nests during the monsoon (probably August). When at the entrance of a small weedy lagoon it drizzled slightly and almost immediately a number of big fish started 'turning over' all around us showing only the dorsal fin above the surface of the water, rather like dolphins. In a few minutes, the drizzle stopped and with it the fish. A little later, there were two short drizzles both with the same effect. The rain appeared to 'switch on' these fish which were almost certainly Rohu [*Labeo rohita* (Ham.)]

Rohu fry were introduced into Powai in the middle thirties by the late Mr. H. B. Hayes and last year members of the Angling Club caught, along with other fish, 268 Rohu totalling 3,592 lbs. (average 13.4 lbs.), largest 35 lbs.

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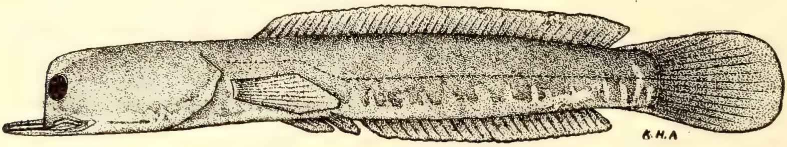
HUMAYUN ABDULALI

23. NOTE ON AN ABNORMAL SPECIMEN OF THE MURREL, *OPHICEPHALUS STRIATUS* BLOCH[1].

(*With a text figure*)

While netting one of the ponds in the Chetput Fish Farm, Madras, on 7th August, 1947, an abnormal specimen of Murrel, *Ophicephalus striatus* Bloch., with a curiously deformed upper jaw, was obtained in the catch. Since existing literature on structural abnormalities in the murrels does not appear to have recorded such a feature, a brief description of it is given below:



Abnormal specimen of the murrel, *Ophicephalus striatus* ca. ½; natural size. Slightly diagrammatic; scales not shown.

The body dimensions detailed below will convey an idea of the anatomic proportions of the abnormal specimen.

Total length from tip of lower jaw to tip of tail	195 mm.
Length from anterior margin of head to tip of tail ...	184 mm.
Length from hind margin of orbit to hind end of head ...	35 mm.
Length from hind end of head to tip of lower jaw ...	54 mm.
Diameter of the eye	9·5 mm.
Width of interorbital space...	10 mm.
Height of head (floor of mouth to dorsal aspect of head) ...	19 mm.
Distance between tip of lower jaw and the angle of the jaws	23·5 mm.
Vertical range in which the mouth could be opened ...	4–5 mm.

The upper jaw, immediately in front of the level of the eyes, is smoothly truncated and directed vertically downwards to the floor of the mouth to a point almost midway between the angle of the jaws and the tip of the lower jaw. Consequently the lower jaw projects prominently forwards (text fig.). Even if forcibly stretched forwards the tip of the upper jaw would not reach that of the lower. The eyes are situated at the anterior margin of the head, with the nostrils close to the inner margin of each orbit. The lower jaw is provided with several teeth—small near the anterior margin and two long pointed ones on each side. The tongue on the floor of the lower jaw is fully exposed. The effective vertical range of movement of the jaws is limited to 4-5 mm.

The general condition of the fish was observed to be poor and it was infested with lernaeid parasites.

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[1] Published with the kind permission of the Chief Research Officer, Central Inland Fisheries Research Station, Barrackpore.

While the angle of the jaws extends behind the level of the eyes as in the normal specimens, the limited gape of the mouth hampers normal feeding and is mainly responsible for the poor condition of the fish. At the time of netting, the stock of murrels in the pond was only 10 months old and the normal specimens averaged 12 inches in length and about 7 ounzes in weight. The specimen under discussion, though presumably of the same age, was only less than $\frac{2}{3}$ the normal length. The difference in the rate of growth in the same environment, in this particular instance, is attributable to the abnormal condition of the mouth which is an obvious handicap in feeding.

A thorough examination of the mouth parts shows that the abnormality of the upper jaw is not the result of any injury sustained during the late larval life, but is probably due to some abnormal strain that prevailed upon the developing embryo or the early hatchling. It is interesting that despite the handicap in feeding, the specimen survived in the natural pond for about 10 months, amidst its cannibalistic brethren.

In this connection it may be mentioned that the writer observed certain dwarf specimens consisting about 30% of a brood of *Ophicephalus punctatus* Bloch, collected from the Chetput Fish Farm, in 1946. The length of the dwarf specimen was only about half that of the normal fry. The head portion was of normal dimensions, while the trunk was very much abbreviated. Alizarin preparations showed the dwarf specimens also having the same number of vertebrae as the normal fry, but the vertebral centra were very thin. Except for size the dwarf specimens were quite normal and were feeding along with the rest of the brood when they were collected. The causes which might have led to the development of such considerable percentage of abnormal specimens in the particular brood are not clear.

The specimen with the abnormal snout has been preserved in the museum of the Freshwater Biological Research Station, Government Fisheries, Madras. The writer is indebted to Dr. T. J. Job for his valuable suggestions in the preparation of this note.

Central Inland Fisheries Research Station,
Barrackpore, K. H. ALIKUNHI
15th June, 1950.

24. OCCURRENCE OF THE FISH *DANIO AEQUIPINNATUS* (McCLELLAND) IN NELA BILAM—AN UNDERGROUND CAVERN IN KURNOOL DISTRICT, SOUTH INDIA

In view of the public interest aroused by an article on 'Nature's Work of Art Underground' by R. K. Golikere published in the *Sunday News of India* dated March 27, 1949, I visited Nela Bilam (Telugu for 'underground cave') in the Kurnool District, South India, on behalf of the Society on 7th October 1949.

The cavern is in the premises of a Siva temple, now in partial ruin, situated in semi-desert country strewn with scrubby vegetation and surrounded by small hillocks all round. The chasm is 200 feet in length and 50 feet in depth in sandstone and limestone. A flight of 203 steps leads to the pool at the bottom, 4 feet in diameter, and 3 feet deep, with a sandy bed and containing clear but slightly brackish water. A stream flows gently into the pool from a northerly direction and continues its course southwards through another hole. There is complete darkness except for a few feet from the entrance. Water is constantly trickling all over the entire cavern forming stalactites containing calcium carbonate—chalk—and quartz.

In the pool I found large numbers of the fish *Danio aequipinnatus* (McClelland) which is not mentioned in the 'Freshwater Fishes of Madras' published by B. Sundara Raj in the *Records of the Indian Museum,* **12** : 249 (1916).

Day's Fauna of British India—Fishes—Vol. I, p. 356 (1889) includes the Deccan in the distribution of this fish. Local enquiries indicate that the water is perennial and though in summer its level goes down, the fish are always present.

In spite of these conditions of life the fish appeared to be quite normal regarding structure and colour. There was no trace of any vegetation in the pool.

114, APOLLO STREET,
BOMBAY, V. K. CHARI,
24th August, 1950. *Asst. Curator.*

25. WHERE DO BUTTERFLIES GO?

In sub-tropical regions such as the plains of Assam where there is rarely, if ever, a true hibernating phase in a butterfly's life history, there yet seems to be a period in the year when a common species becomes rare in its usual haunts. The problem of what has happened to them during this period first began to interest me in connection with the various species of *Lycaenopsis,* common here in the cold weather, but of great rarity during the rains.

My collecting territory is the thick evergreen forest and adjacent tea gardens at the foot of the Naga Hills in the Sibsagar District of Upper Assam. Here, though the cold weather (approximately December-February) is well marked, it is not sufficient to prevent the continuous brooded species from hatching out; and an equally important climatic factor is probably the excessive humidity of the rainy months May-October.

The easiest group to assess is that of the cold weather migrants, the two principal ones being *Pieris brassicae* and *P. napi.* These are both mountain species, *P. napi* occurring only as an occasional winter visitor, but *brassicae* coming down in numbers to wreak havoc amongst the cabbages and nasturtiums. With the advent of the humid weather the pupae of the latter species rot, even if kept in an airy room and out of direct contact with the rain. Another possible migrant from the hills is *Vanessa canace*: an occasional specimen may be taken here at any season, but it is said to be delicate in the pupa stage and I am doubtful if it can maintain itself down here. *Pieris canidia,* common during the cold weather, becomes rare during the rains, but this is probably connected with the plentiful supply of *Brassicae* during the former season, while in the rains its only foodplant appears to be a somewhat uncommon little cruciferous plant growing in the sheltered rain water drains around the bungalow, so that it becomes dependant for its livelihood upon the poor sight of the sweeper. Another migrant is *Lampides boeticus,* which, after being exceedingly plentiful amongst the leguminous green crop during the cold weather, becomes an extreme rarity during the rains.

Jamides kankena and *J. alecto* are common along jungle paths from December onwards, but *kankena* I had till recently considered a rarity in its W.S.F. Recent experience has shown me, however, that at this season it shuns the open paths and keeps, together with *alecto,* to the dense shade of bamboo jungle, this being true of both sexes. The genus *Lycaenopsis* presents a more difficult problem. *Puspa* and *cardia* are common, and *transpecta* (♀♀ only and *lavendularis* occur sparingly, from December to June, but after that month the only *Lycaenopsis* I have met is an occasional *puspa.* I suspect this may represent a seasonal replenishment from the hills, but doubt if the same holds good for *Jamides bochus* which is one of the commonest *Lycaenids* from December to June, and then disappears almost as completely as *Lycaenopsis cardia.* It is more likely that this species (*bochus*) can maintain itself, but only with difficulty, in the plains during the rains.

The reverse problem, of those species common during the summer and rare during the winter, is easier, since one can always postulate a 'partial emergence' such as is common in temperate climates. Of these the most striking examples are afforded by *Nacaduba nora* and *N. dubiosa* which occur together in myriads from June to September, but become real rarities during the cold months.

Two common species which are erratic in their occurrence are *Spalgis epius* and *Gangara thyrsis.* *S. epius,* because it is at a pastoral and nomadic level, must presumably follow its herds. In June it is plentiful in a certain section of tea, from which it completely disappears to come and act as *Aphis* destroyer in my compound when the pest is at its worst on the *Citrus* bushes. The last brood of the year occurs in neither of these localities, but is plentiful in a very limited area of secondary jungle. *G. thyrsis* has its foodplants in my compound, and is abundant in any stage from ovum to imago, at most times of the year. This species appears to be continuous brooded, yet seems to disappear from March to June, leaving no trace of any stage of its life history. Where has it gone, and why? Climate can have little bearing on this problem, and its foodplants at that season appear to the human eye no different.

Of direct bearing on the title of this article are two recent experiences. Any sunny day in July and August 1949 I could stand in a certain section of tea and watch the rare *Amblypodia camdeo* flying by. They were passing in either direction at the rate of not less than one a minute, 3 or 4 frequently being in sight at a time. All specimens caught were ♂ ♂ and their line of flight was so regular that barring a few stragglers their path over the tea was a lane 10 yards wide. Not infrequently specimens alighted on tea bushes and sat with closed wings until disturbed, but the greater number disappeared into the distance in either direction. I was never able to find either their source or their destination, but the two-way traffic was particularly unusual and intriguing. My guess is that the destination may have been some particularly attractive nectar producing plant, but if so, why the definite traffic lane and how did they form up in it at the beginning? I was able to observe this occurrence frequently for several weeks. This year I have so far (mid July) only seen one specimen, but still flying along the same traffic lane. I had a somewhat similar experience in May at 5,500 feet in the Naga Hills. A stream of *Appias nero,* both sexes and one or two at a time, was flying across the compound of the Inspection Bungalow at Jhakama. On this occasion the traffic lane was about 100 yards wide and nearly all the insects were going in the same direction, but once again the striking fact was that all the insects of a particular species in the one neighbourhood had chosen a particular line of flight. Lower down, at about 4,500 feet, *A. nero* was extremely plentiful, flying fast in all directions, but appearing to be making straight for certain nectar laden creepers. One might surmise that at the higher level also the insects were flying from their breeding grounds to a particularly attractive source of nectar.

Without touching on rare species—who would not like to know where these go?—it is interesting to speculate where the females (or in the case of *Lethe satyavati,* the males) hide themselves. In this connection one thinks immediately of the genera *Charaxes* and *Eriboea,* whose females are apparently the greatest rarities, and whose males are relatively common. If the sexes were equally common one would at least expect to see the 'rare' sex, even if inaccessibly at the top of a tree, but this is not the general experience. And yet I am doubtful if there is likely to be any discrepancy in the sexes at emergence, even in species were one sex is more commonly seen than the other. A possible answer is that the females are attending to their maternal duties round a few unwholesome looking (to human eyes) foodplants in the depths of the jungle—a habit well known in, for instance, the only British species of *Limenitis.*

Note: Nomenclature taken from the 2nd edition of Brigadier Evans's 'Identification of Indian Butterflies'.

Seleng T.E.,
Seleng Hat P.O.,
Upper Assam,
25*th July,* 1950.

T. NORMAN

26. THE EARLY STAGES OF *LYCAENOPSIS HUEGELII*[1]

De Nicéville has described the early stages of the closely allied *L. argiolus*, but I can find no description in the literature of the early stages of *huegelii*. This butterfly occurs in great numbers on the Khasi plateau at around 6,000 ft. At the beginning of September all stages, from ovum to imago, abound; and I have found all stages again at the beginning of March, though in much smaller numbers.

The foodplant is *Prinsepia utilis* (Rosaceae)[2], and I watched females ovipositing on this in bright sunshine at midday in early September. Though much time is spent in selecting a suitable site for each ovum, the final result on numerous bushes was the same, the ova being placed indiscriminately on the stems and on both surfaces of the leaves, no attempt being made to place them on growing points or at the base of stems and bracts as is the habit with many of the *Lycaenidae*. The ovum is small for the size of the insect, and dirty white in colour, not appearing to undergo any colour changes with age. It is of the usual *Lycaenid* disc shape, with conspicuous micropyle.

The larva, which is not attended by ants at any stage, measures 12 × 4 mm. when fully fed, being broadest anteriorly. The head is shiny black and retractile. The ground colour is variable, usually light apple green with a pale longitudinal streak on either side of the mid-line, and a faint yellow lateral stripe. It is completely clothed with short downy hair. Only the under cuticle of the leaf is eaten, the ravages of the larvae being such that some bushes appear to be entirely covered with skeleton leaves.

The pupa is attached most insecurely by a girdle to the under side of a leaf of the food plant. It is 9 mm. long, and the thorax and abdomen are covered with downy hair. Most specimens become a fairly dark brown, being lighter on the abdomen, which has a variable series of dark spots. There are two dark spots ventrally at the junction of thorax and abdomen.

No parasites were obtained from a dozen pupae, and I saw no *hymenoptera parasitica* about the bushes.

Seleng T.E.,
Seleng Hat P.O.
Upper Assam, T. NORMAN
7th June, 1950.

[In the *Journal* Vol. 40, pp. 134-135, A. E. Jones has a note on the differences between *Lycaenopsis huegelii huegelii* and *Lycaenopsis ladonides gigas* accompanied by photographs.—Eds.]

27. BROWNISH-YELLOW FORMS OF *PAPILIO DEMOLEUS* L.

The foot-note to Mr. Menesse's remark on this subject in his paper on the Butterflies of Sind (1950, *Journ. Bomb. Nat. Hist. Soc.*, xlix, 21) is very far from complete.

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[1] H21. 22 in Evans's 'Identification of Indian Butterflies' (2nd edn.). Presumably subspecies *oreana* Swin.

[2] I am indebted to Mr. F. Kingdon Ward for the identification of this plant.

Apart from the fact that I consider the use of the term 'fade' an incorrect description of the change from pale yellow to dingy brown, the change is a definite chemical one in the constitution of the pigment and is caused by a combination of heat and humidity. It occurs not only in *P. demoleus* but also in the closely allied African *Papilio demodocus* Esp. and in other species with the same pale yellow pigment. The change can take place in cabinet specimens as well as in living insects.

Cockayne (1924, *Trans. ent. Soc. Lond.*, 6) records that whilst the unchanged yellow pigment fluoresces with a brilliant blue-green colour, the brown pigment into which it is converted is non-fluorescent.

KAMPALA, D. G. SEVASTOPULO,
29th June, 1950. F.R.E.S.

28. SEASONAL FORMS OF *CATOPSILIA* SPP.

Whilst Mr. Wynter-Blyth's foot-note to Mr. Menesse's paper on the Butterflies of Sind (1950, *Journ. Bomb. Nat. Hist. Soc.*, xlix, 21) correctly records the modern theory that *pyranthe* L. and *florella* F. are merely seasonal forms of one species, it does not mention the even longer held belief that *crocale* Cr. and *pomona* F. are again only the seasonal forms of one another.

To me, in neither case, does the explanation of mere seasonal variation appeal, and I would like to put forward the following slightly more complicated hypothesis.

Genetical work in England on *Panaxia dominula* L. (Arctiidae) and *Rhodometra sacraria* L. (Geometridae) has domonstrated the existence of genes that only reveal themselves when the early stages are passed at certain temperatures. If the critical temperature is not experienced the gene, even if homozygous, produces no effect and the imago appears to be normal. I would like to suggest that the differences that separate *crocale* from *pomona* and *pyranthe* from *florella* are due to a gene, or more possibly a combination of genes, that only shew themselves when the early stages have been passed under certain conditions of temperature and humidity. Experimental proof of this hypothesis would come from rearing part broods of known parentage under different conditions of temperature and humidity.

Some support for this hypothesis seems to be afforded by the fact that *C. florella* occurs in Africa and, in spite of the very pronounced seasonal dimorphism exhibited by many species of butterfly, does not itself so vary, the form being akin to that considered dry-season in India. In Africa, incidentally, apart from other differences from the Indian form, the female is dimorphic, there being a yellow female form, with a deep yellow underside, in addition to the usual whity-green, male-like female.

KAMPALA, D. G. SEVASTOPULO,
29th June, 1950. F.R.E.S.

29. FOOD-PLANT OF *DELIAS EUCHARIS* DRURY

The food-plant of the whole genus *Delias* is generally considered to be *Loranthus* spp. and I was surprised to read Mr. Harman's record of pummaloe (*Journ. Bomb. Nat. Hist. Soc.*, 49: 94, 1950). Can Mr. Harman actually confirm that the larvae fed on the foliage of the pummaloe and not on that of a *Loranthus* parasitic thereon?

Also what is 'ohangi'?

KAMPALA,
29th June, 1950.

D. G. SEVASTOPULO,
F.R.E.S.

[This letter was sent to Mr. A. C. Harman for confirmation and he replies as follows:—

"I can confirm that I found the larvae of *Delias eucharis* feeding on pummaloe [*Citrus grandis*] and also found eggs laid on the pummaloe leaves. I was much surprised as I have only known the larvae to feed on *Loranthus* parasite previously.

This incident occurred only during my last year in India, in Behar, so I do not know if it were a habit and doubt it!

'Ohangi' is a misprint for 'bhangi' which is the local vernacular name for *Loranthus*.'—EDS.]

30. OCCURRENCE OF THE FAIRY SHRIMP, *APUS*, IN A TEMPLE TANK IN TIRUNELVELI DISTRICT, MADRAS

One specimen of the phyllopodan entomostracan, *Apus*, was collected from the Nagasunni Temple Tank at Sankaranainarkoil, Tirunelveli District, during one of my fishery investigations in April 1949. Dr. S. L. Hora, Director, Zoological Survey of India, to whom the specimen was sent, has sent the remarks of Mr. K. K. Tiwari, carcinologist in the Survey, to the effect that 'the specimen of *Apus* does not appear to belong to any of the (known) species but since there is only a single specimen, and the genus shows sufficient variability, it is not possibile to be sure of its identity, unless more material is available.' M. K. K. Tiwari has examined the material of *Apus* in the collection of the Zoological Survey of India and is now definitely of the opinion that it is related to *A. sudanicus* Brauer, though perhaps not quite identical with it. Further efforts made by me to obtain more specimens were unsuccessful.

The occurrence of *Apus* in the plains of India under tropical conditions is very rare. So far it has not been recorded from South India, and the only previous records of this genus in India, known to me, are from Kashmir, Bulandshahar (U.P.) Panchgani, and Gujerat. Its occurrence in South India is, therefore, interesting and completely confirms to the general view about the erratic distribution of this genus.

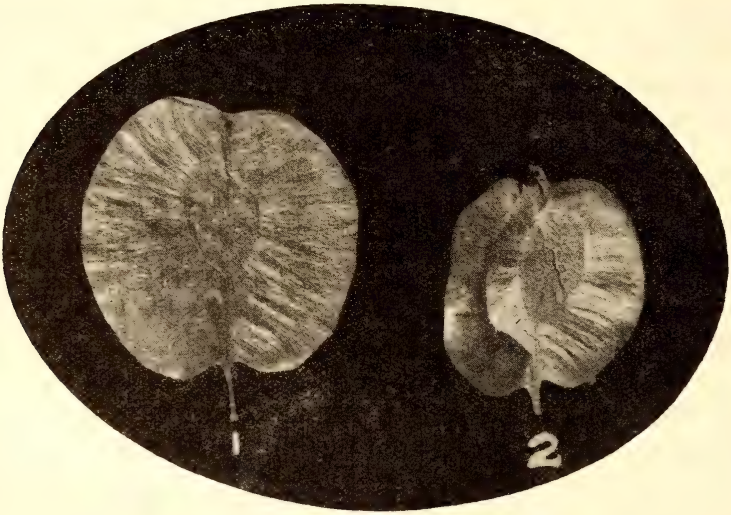
FRESHWATER BIOLOGICAL STATION,
KILPAUK, MADRAS.
11th September, 1950

P. I. CHACKO

31. A FOUR-WINGED SAMARA IN THE INDIAN ELM *HOLOPTELEA INTEGRIFOLIA* PLANCH.

(*With a photo*)

Holoptelea integrifolia Planch. is a common deciduous tree which sheds its leaves in January-February, when the tree presents an unique appearance with its flat green samaroid fruits which may be mistaken for leaves. The ovary is composed of one or two carpels, usually unilocular containing a single seed. The fruit is a thin, compressed, obscurely rounded membranous body, surrounded by the wing which is really the expansion of the pericarp, the seed being contained in the central portion (fig. 1). A case was noticed where, in addition to the normal ovate wing there were two perpendicular wings, these being similar to the normal ones though smaller in size. Three wings can be seen in a view, one being hidden. (fig. 2). In the seed-containing portion of the fruit a smaller seed was found in addition to the usual one. Four stylar branches were noticed in the place of the normal two. Proper explanation for this abnormality will be that in this particular fruit both the carpels and the locules have developed and hence the two additional wings, two seeds and four stylar branches. Jivanna Rao (*Madras Agrl. Journ.*, June 1930) has recorded functioning stomata in the wing-like portion and the same were observed in the accessory wings also.



BOTANY SECTION, AGRICULTURAL
COLLEGE & RESEARCH INSTITUTE,
COIMBATORE.
13th *July*, 1950.

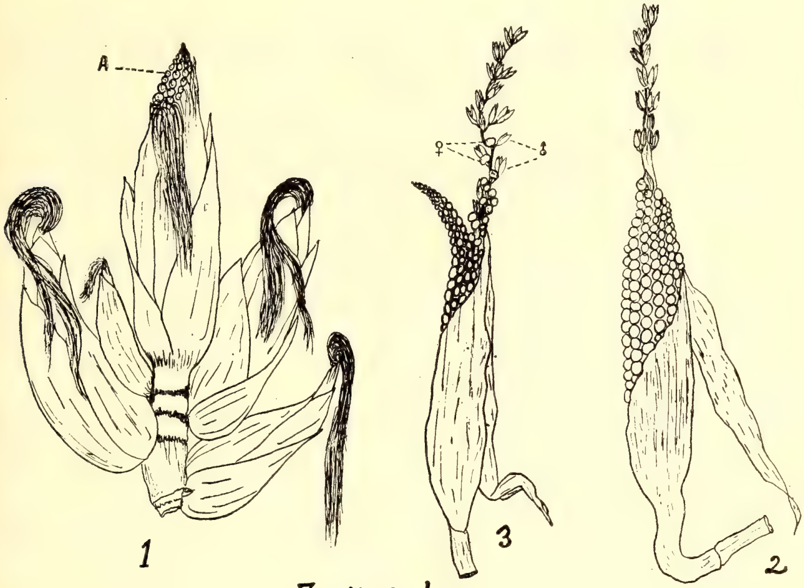
S. N. CHANDRASEKHARAN
J. SAKHARAM RAO

32. TWO INTERESTING ABNORMALITIES IN THE COMMON INDIAN CORN, *ZEA MAYS* LINN.

(*With three text figures*)

Variability is of common occurrence among cultivated plants. In a number of cases, the variations are clearly of the 'congenital' type. Their causes cannot be traced in all cases definitely and one has to remain satisfied with the oft-repeated inference that such variations are due to the 'inherent tendency of organisms to vary'.

The author of this note in 1934 described an abnormal type of the 'Insertion of the leaves and the head in *Helianthus annuus* Linn,' which has long been under cultivation. Closely related phenomena have been recently observed in the commonly cultivated plant *Zea mays* Linn., and it is hoped that they too may prove interesting to students of plant life in general and of plant-teratology in particular.



ZEA MAYS LINN.

1. In a fruiting specimen collected recently from the fields, the female inflorescence, the ear, was a branched one instead of the normal axillary solitary type. The abnormal type (fig. 1) consists of an axis, on which five nodes and four internodes are very distinctly seen, and each of the four nodes below shows a sessile ear borne laterally; all these ears are in the same plane and are thus distichous. The last internode bears an ear (the largest of them all) at the apex (A); this ear bears the immature flowers and has developed chlorophyll (oolysis). The lateral ears, which are smaller than the terminal one, do not show full development of all their fertile flowers. All the ears show the terminal tuft of silky styles.

An abnormality of this type in which a normal inflorescence is branched to repeat and thus increase the number of parts is clearly a mutation and more particularly an instance of meristic variation. It appears to come under the category of the abnormalities called 'Mischomany' (Ch. Morren).

2. In another specimen also collected locally, the axis bearing the ear (fig. 2) has grown beyond the cob of the ear and bears the male or staminate inflorescence; another similar abnormal ear (fig. 3) bears at the base the male and the female spikelets side by side, reminding one of the arrangement in the spike of the coconut-palm. This abnormality bears close resemblance to that described under 'recrudescence'.

BIOLOGY DEPARTMENT,
RAJARAM COLLEGE, KOLHAPUR.
13th June, 1950.

S. A. PARANDEKAR,
M.SC.

33. SOME PHENOLOGICAL NOTES ON *DILLENIA INDICA* LINN.

While collecting flowers and fruits of *Dillenia indica* Linn., for the past three years at the Government Botanic Gardens, Bangalore, for embryological study, some interesting phenological observations were made. These are described below.

The genus *Dillenia,* a member of the Dilleniaceae, has a distribution in tropical Asia of which four species are reported from south India by Gamble. *D. indica,* a round-headed tree of some silvicultural importance, has a short main stem from which arise a number of spreading branches all round; these in turn bear large serrate leaves with conspicuous parallel secondary veins.

By the middle of May the leaves begin to fall and by the end of the same month the entire plant is leafless. Immediately afterwards, within the course of a week (i.e., during the first week of June) the leaves begin to appear and along with the young leaves the subterminal solitary flower buds begin to develop. By the middle of June, the entire plant becomes leafy and the flower buds grow in size gradually. A number of old buds which were of a fairly large size on dissection showed that antithesis had taken place. The anthers dehisce by apical pores and when such anthers are shaken the pollen grains are shed through the apical pores in the form of a fine yellow dust.

The drooping flowers usually open in the second week of July. During blooming the quincuncially arranged sepals and the whitish petals, which remain crumpled in the bud, open. The large number of stamens and the radially arranged whitish stigmatic lobes of the apocarpous pistil now become clearly visible. Continuous observation for the past three years has shown that the flowers usually open in the morning and are visited by a swarm of honey bees. By next morning the petals drop off and the five orbicular sepals enclose the essential organs. In some flowers which opened in the morning, all the petals dropped off the same evening. By the end of July a number of fruits are developed. The fruit is a pseudocarp and it actually comprises of the mature indehiscent fleshy carpels enveloped by the thickened fibrous sepals. In the mature fruit, each carpel encloses a number of seeds embedded in a glutinous substance, which is probably secreted by the hairs developed along the margins of the compressed seeds.

DEPARTMENT OF BOTANY,
CENTRAL COLLEGE, K. SUBRAMANYAM
BANGALORE 1,
3rd August, 1950.

34. FURTHER REMARKS ON THE FLOWERING OF *STROBILANTHES*

In continuation of my note in this journal (49: 318, Aug. 1950), I have gathered some more data on this intriguing problem and have formed some idea of the mechanism controlling the general flowering of this plant.

During the first week of September of this year I once more examined Bhoma Hill in Khandala for signs of a general flowering, which I was expecting after the partial flowering mentioned in my previous note. After a whole day's search I did find exactly 22 plants showing buds or flowers.

Blooming plants were all at the edges of dense clumps of *Karvi,* or occasionally standing by themselves on grass slopes. By comparing plants that were in bud or flower with those in the vegetative stage, it was noticeable that the former plants had the appearance of being sickly, half-starved, and in general in a much poorer condition than their neighbours; again, size of the plant did not seem to determine its condition with regard to flowering; some of the plants in bloom had but 2 or 3 leaves, and were about 15-25 cms. high, the colour of their leaves being rather yellowish by contrast with the deep green of their neighbours. Another noticeable feature was that with but two exceptions, plants in bloom were standing at the north or north-west side of their clumps.

A possible explanation of the general flowering of these plants may be that such flowering is induced either by starvation of water, or alternatively by surfeit of carbohydrates that could not be got rid of from the leaves. This point will demand my attention in my next outing; as plants advance in age, their xylem vessels may be blocked by tyloses, in which case shortage of water would naturally follow; or their phloem tubes may be blocked, in which alternative the carbohydrates produced by photosynthesis in the leaves would not be removed to other parts of the plants; in either alternative the result would eventually be the death of the plant in question. A comparative study of the anatomy of these plants in various stages may solve this problem.

After last year's experience, mentioned in my previous note in this journal, I had expected a general flowering for this year; this has not come to be, and on the contrary the events noticed during the general flowering of 1942-1944 seem to be taking place again, in which case a general flowering should be expected for next year. Some time in the near future, I hope to gather sufficient data that may help in the solution of this interesting problem.

ST. XAVIER'S COLLEGE,
FORT, BOMBAY 1.
13th September, 1950.

H. SANTAPAU,
S.J.

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35. THE FLOWERING OF *STROBILANTHES*

In response to your request about the mass flowering of *Strobilanthes*, I am sending the following facts which were mostly either taken from, or checked by Mr. C. G. Webb-Peploe's notes. Some of the specimens about which we were in doubt have been identified by Fr. H. Santapau, and others by Mr. H. K. Airy-Shaw, a friend of one of the Fellowship, who is at the Kew Herbarium.

The specimens were all found in the hills (Western Ghats) which are about 30 miles north of Cape Comorin.

1. *S. neilgherrensis* was in full flower to the north of the valley in which our houses are situated in 1944, and to the south in 1946. This is the *Strobilanthes* which forms the characteristic border of the sholas found on the grassy uplands of these hills. Height about 5,000 ft.

2. *S. anceps* growing with the above was in full flower in 1946, though there were plants in flower in 1944. Height about 5,000 ft.

3. *S. anceps* var. *microstachyus*, found in light evergreen forest, particularly where *Ochlandra* sp. adjoins this forest, was in full flower in 1946. Height about 5,000 ft.

4. *S. helicoides*, found in light evergreen forest was in full flower in 1946. Height about 5,000 ft.

5. *S. tristis*, found within the sholas which are on the grassy uplands, was in full flower in 1946. Height about 5,000 ft.

6. *S. luridus*, also found within the sholas was in full flower in 1946.

7. *S. consanguineus* found in light evergreen forest, flowers every year. Height 3,000 ft.-4,000 ft.

In addition to these we have found *Stenosiphonium parviflorum* and *Stenosiphonium russelianum* which have the same habit as *Strobilanthes*, of flowering periodically and then dying back. *S. parviflorum* was in full flower in 1947, and *S. russellianum* in 1945 with a secondary flowering in 1946. Mr. Shaw of Kew suggests that this genus 'seems quite worthless' and asks for further study in this line. I should value your help as to how to do this. The plants are well grown, and may flower in a few years' time.

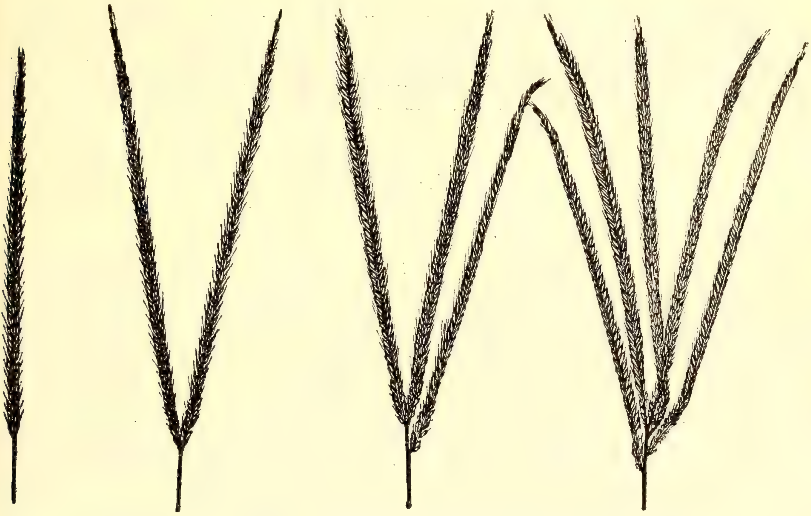
DOHNAVUR FELLOWSHIP,
DOHNAVUR, TINNEVELLY DISTRICT,
SOUTH INDIA.
28th April, 1950.

(Miss) EVELYN BOWDEN

36. A NOTE ON THE POLYSTACHOUS INFLORESCENCE IN *ENTEROPOGON MONOSTACHYOS* K. SCHUM.

(*With a text figure*)

Enteropogon monostachyos K. Schum., (= *E. melicoides* Nees) is a common grass found in almost all the districts except West Coast. The spikes in this are mentioned as solitary by Hooker (1897) and as solitary or twins by Fischer (1934) and Rangachari (1921). Blatter (1935) observes the solitary nature of spikes in the genus. In a majority of the cases the spike is solitary as the name suggests (monostachous = arranged in one spike) and twins are not uncommon.



1, 2, 3, & 5 spikes in *Enteropogon monostachyos* Schum.

It was noticed in the old collections of the Madras Herbarium that some of the specimens bore 3 and 5 spikes. In the case of two, both the spikes start from the same place but as regards the 3 and 5 spikes it was seen that two of them arise from the same point, the rest arising lower down. The character of the accessory spikes was essentially the same as the normal ones. The phenomenon is interesting inasmuch as the genus is placed in *Chlorideae* nearer the genera *Cynodon* Pers., and *Chloris* Sw., which possess more than 3 or 4 spikes having more or less the same characters as *Enteropogon*. The progeny tests are conducted to observe whether the phenomenon is repeated. All the specimens were collected by Sri S. Ramaswamy Raju in the Agricultural College Estate on 19-7-1935 and these were found mounted in the following sheets of the Madras Herbarium, Coimbatore.

2 spikes — M.H. No. 83068. C.
3 spikes — M.H. No. 83068. B.
5 spikes — M.H. No. 83068. A.

The authors extend their thanks to Mr. K. A. Ayyappa, B.SC., for the drawings accompanying this note.

BOTANY SECTION,
AGRICULTURAL COLLEGE & RESEARCH INSTITUTE,
COIMBATORE,
22nd August, 1950.

S. N. CHANDRASEKHARAN
J. SAKHARAM RAO

REFERENCES

1. Hooker: Flora of British India. Vol. VII. pp. 284. William Clowes. & Sons, Ltd., London.
2. Fisher: Flora of Madras Presidency. Vol. X. pp. 1834. Adlard. London.
3. Rangachari: South Indian Grasses. pp. 246-247. Govt. Press Pub.
4. Blatter: Bombay grasses. pp. 251—I.C.A.R. Publication.

37. GLEANINGS

Tap-dancing by Mouse-deer.

In *Country Life* dated 21 April 1950, p. 1115, in an article entitled 'The Tap-Dancer of the Forest' John E. Kempe refers to the mouse-deer in Perak, Malaya, which is attracted to a small clearing in the forest by a Malay forming a pad with six broad leaves and patting them lightly with his fingers. A squirrel and fireback pheasant appeared in a few minutes to investigate and after about ten minutes there was a 'tappety tap' answer to the noise and a mouse-deer stole into view. "Forelegs stiff and straight, hind feet drummed a fascinating roll on dry leaves. Did Pandak (the Malay) change the rhythm, it was echoed, tap for tap. 'Tappety, tap, tap', went the fingers; 'tappety, tap, tap', beat the mouse-deer's hoofs. Advancing slowly, it plucked a leaf, we could see it chewed and deliberately swallowed, but the drumming never ceased." Coming within a few yards it could not apparently discern the three men hidden behind a frail screen of leaves; then it possibly caught their scent and in an instant with a flirt of the tail, it vanished into the undergrowth. This is apparently a well-known method of calling up this small deer.

The Age of Goats.

From 'Lord Anson's Voyage round the World—1740-1744' by Richard Walter, M.A., abridged and annotated by S. W. C. Pack (A Penguin book).

'The island of Juan Fernandes abounded with vast numbers of goats . . . Alexander Selkirk who stayed here between four and five years, relates that as he often caught more goats than he wanted, he sometimes marked their ears and let them go. This was about thirty-two years before our arrival at the island. Now it happened that the first goat that was killed by our people at their landing had his ears slit, whence we concluded that he had doubtless been formerly under the power of Selkirk. This was indeed an animal of a most venerable aspect, dignified with an exceeding majestic beard, and with many other symptoms of antiquity. During our stay on the island we met with others marked in the same manner, all the males being distinguished by an exuberance of beard and every other characteristic of extreme age'. (Alexander Selkirk is believed to be the origin of Defoe's Robinson Crusoe).

Major S. S. Fowler in his 'Contribution to our knowledge of the duration of life in vertebrate animals—mammals' [*Proceedings of the Zoological Society*, London (1931) p. 209] gives the average age of domestic goats as 8 to 10 years while an individual was known to live for 17 years.

'Tall' Birds.

Foster D. Smith Jr., in 'A Contribution to the Ornithology of North-eastern Venezuela' (*Proceedings of the U.S. National Museum*, 1950: p. 443) writes of a Swallow-tailed Kite—*Elanoides forficatus yetapa* (Vieillot):

'The present specimen was taken by firing the shotgun repeatedly straight up in the air. As the spent wad reached its zenith the bird dropped lower to inspect it, finally coming within range.'

Orientation in Migratory Birds.

Julian Huxley in 'Birds and Science' (a review of the 10th International Ornithological Congress), *Country Life*, 4th August 1950, page 367:

"In some ways the most original and exciting new work reported at the Conference was that of Dr. Kramer of Welhelmshafen, who has been studying the direction of flight during migration—on captive birds ! He discovered that during the migration period starlings kept in a suitable cage would perch or flutter towards one particular direction —that which they would have taken if they had been free. But, more than that, by an ingenious arrangement of mirrors he proved that the direction of the sun's light determines the direction chosen. By manipulating mirrors at a number of openings round the cage, he could make birds which normally gathered towards the S.W., gather at the opposite or N.E. side, or half-way round towards the N.W. Here at last is a core of hard fact in the welter of speculations as to how birds find their way, a known natural phenomenon instead of a mysterious 'sense of direction' or a hypothetical reliance on magnetism."

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING 31st DECEMBER 1949.

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HONORARY SECRETARIES' REPORT FOR THE YEAR 1949

THE SOCIETY'S JOURNAL

During the year parts 2, 3 and 4 of Vol. 48 were published and it seems that we are at last catching up with our arrears and that it will soon be possible to publish the three journals according to schedule.

Several members have drawn attention to the desirability of publishing a fourth part every year, and the suggestion has been carefully examined by the Committee. Though this might result in a diminution in the size of the journal, the extra cost would not be prohibitive; but in the absence of any wholetime assistant on the editorial side, the Honorary Editors are reluctant to take on this additional work. The matter is, however, in mind and suitable arrangements will be made as soon as possible.

MAMMALS

On the sporting side three parts of Lt.-Col. Phythian-Adam's serial on 'Jungle Memories' were published. Attention has been drawn to the matter of the preservation of wild life in 'The Gir Forest and its Lions' by M. A. Wynter-Blyth. From this article it is evident that the action taken by the rulers in Kathiawar has saved these animals from extinction which seemed imminent in the early part of this century. It is hoped that the recent changes in administration will not be allowed to affect the position adversely in any way.

Col. Burton has an article supplementary to his original paper on the Preservation of Wild Life and Mrs. Jamal Ara reports on the various sanctuaries in Bihar. Humayun Abdulali in 'Sex Ratio in Indian Bats' draws attention to the curious preponderance of females in almost every species of bats collected by the Society's Mammal Survey and reiterates the necessity for more field work and observations. Mr. A. F. Hutton has a useful paper on the Mammals of the High Wavy Mountains based mainly on his personal observations.

BIRDS

Papers on birds include 'Notes on the Nesting Habits of 7 representative tropical Sea Birds' by C. A. Gibson-Hill and another on 'A Pelicanry in the West Godavari District' by K. K. Neelakantan. Mrs. M. D. Wright has attempted a census of the bird population at Dhera Dun, while Mrs. Desirée Proud has a list of birds seen in the Nepal Valley during a year's residence.

The distinguished German ornithologist, E. Stresemann, assisted by J. Arnold contributes a valuable paper entitled 'Speciation in the group of Great Reed Warblers'.

Other regional papers are W. L. Roseveare's 'Notes on Birds of the Irrigated Area of Shwebo District, Burma' and Col. R. S. P. Bates's account of 'The Merbal Glen and some birds of the Pir Panjal' accompanied by his usual excellent photographs.

REPTILES AND AMPHIBIANS

A. F. Hutton's note 'The Snakes of the High Wavy Mountains' is the only contribution during the year. This includes a description of a new Pit Viper named by Dr. Malcolm Smith after Mr. Hutton.

FISH

Five papers on fish and fisheries include a note by Mr. P. K. Jacob on 'The Bionomics of Ribbon Fishes', 'A list of Fishes from the Kumaon Himalayas' by A. G. K. Menon and a note on 'A collection of Fish from Travancore' by E. G. Silas. Dr. S. B. Setna describes some local fishing methods in 'Bombay Fishermen's Ingenuity'.

INVERTEBRATES

The late Mr. James Hornell's contribution 'The Study of Indian Molluscs' was published as a serial in 3 parts. It is proposed to bring this out in book form which we trust will be of interest to members.

Three parts of the late Mr. Martin Mosely's papers on 'The Indian Caddis Flies (Trichoptera)' conclude an important serial. Other papers include 'The Insect Fauna of a Cotton Field at Lyallpur' by Abdul Hameed Khan, 'Bombay Crop Pests Calendar and Seasonal Schedule of their control by Modern Insecticides' by E. J. Vevai and G. M. Talgeri. Mr. D. G. Sevastopulo has a supplementary list of the Indian Bombycidae, Agaristidae and Noctuidae.

BOTANY

Fr. H. Santapau's 'Artificial Key to the Papilionaceae of Bombay Province' and 'Notes on the Gesneriaceae of Bombay' are two papers of popular and systematic interest.

Mr. M. B. Raizada reports on several new plants from Orissa obtained by Dr. Mooney.

Mr. M. A. Wynter-Blyth's 'Nilgiris Revisited' is an interesting account of the faunal and floral residents of the hill. We wish we could secure more articles of this kind to add to the general interest of the wandering naturalist and tourist.

The usual inflow of miscellaneous notes continued and we would again ask members to write to us in connection with the smallest incidents which they may experience, but which may possibly prove to be the missing link in a chain of investigations. It is hardly necessary to reiterate that a large volume of interesting and valuable information is embodied in the miscellaneous notes, and this section, we believe, is also one of the most popular features of the *Journal*.

PUBLICATIONS

No fresh publications were brought out during this year but we are still urging Messrs. Oliver & Boyd, Edinburgh, to expedite the printing of 'Some Beautiful Indian Trees' by Blatter and Millard which was entrusted to them over 3 years ago!

Sales of existing stocks have not been encouraging, and the appreciable amounts invested in these books hinder our plans for further publications.

THE SOCIETY'S ACTIVITIES

In November 1949, Mr. Sálim Ali, accompanied by two assistants from the Natural History Section of the Prince of Wales Museum, carried out an ornithological survey of the Orissa States area. About 450 birds and some mammals were obtained and some interesting information should become available when the collection is worked out and the results published in the *Journal*.

With the inauguration of the Directorate of Parks and Gardens the Government of Bombay has been showing keen interest in the matter of Wild Life Preservation. Mr. Humayun Abdulali, who represents the Society on the Parks and Gardens Advisory Committee, was elected to a sub-committee dealing with the drafting of a bill for the preservation of wild birds and animals in the State. Draft copies of the proposed legislation—which is a compendium of the most desirable features in the shooting and game rules existing in the various Indian provinces and the United Kingdom—were circulated to many interested and competent members for opinion and a large amount of helpful co-operation was forthcoming. The bill has been approved by Government and it is hoped that it will soon become Law.

The Society received an invitation from the International Ornithological Congress to send a delegate to attend the 10th Session of the Congress to be held at Uppsala (Sweden) in June 1950. As the Society's finances would not permit this expenditure, the Committee issued an appeal for contributions from members which we are glad to report made it possible for us to send Mr. Sálim Ali as our representative. We would take this opportunity of thanking our members for their generous response.

As suggested at the last Annual General Meeting, an attempt was made to provide local members with films and talks on natural history subjects, but as then suspected, there is a great paucity of suitable material to draw upon, and only two such shows could be arranged during the year.

On 19th August a film strip talk on 'National Parks in the U.S.A.' was delivered by Mr. Wayne M. Hartwell of the United States Information Service. On 5th October Mr. Sálim Ali exhibited a movie colour film made during his trip to Assam to report on the Wild Life Sanctuaries of that province earlier in the year.

The Society's Committee would greatly welcome offers from members or their friends to show at meetings any movie films of natural history interest made by them on fishing, shooting, mountaineering or trekking expeditions, and the like.

NATURE EDUCATION

The Nature Education Scheme undertaken in collaboration with the Educational Department of the Government of Bombay is progressing and during March/April about 2,000 pupils belonging to 39 schools attended talks and guided tours through the Natural History galleries. This was followed by a series of talks to teachers of secondary schools covering the basic principles of the study of plants. Gallery talks in English, Marathi and Gujarati were arranged on Sundays for the benefit of the public but were discontinued for want of sufficient response. This may possibly be due to lack of sufficient publicity.

The plant study scheme for children included the issue of sheets covering common familiar plants, illustrated with line drawings, with a questionnaire in English, Hindi, Marathi and Gujarati. Two such sheets were issued, and as the cost is only ½ anna per sheet they should be within the means of every student. They have had a favourable reception from teachers as well as pupils.

REVENUE ACCOUNT

The total receipts during the year amounted to Rs. 48,794-12-4 as compared with Rs. 37,796-7-7 for 1948. The increase of Rs. 10,998-4-9 is partly due to grants received from the Governments of India and Bombay and partly to the increase in the annual subscription.

The total number of members on our books on 31st December 1949 was 1433 i.e. an increase of 35 over 1948, but subscriptions were actually realized from only 767 members.

The sales of the Society's publications have dropped considerably and after allowing for necessary depreciation, the total net profits are much less than those realized last year. The Committee have several additional publications in mind, but are awaiting a reduction in the stock position before incurring further outlay.

STAFF

Mr. N. G. Pillai whose services were loaned from the Government of Travancore took over charge as Curator from 1-2-1949 until 31-1-1950 vice Mr. Sálim Ali, who relinquished his temporary appointment.

The Committee wish to record their appreciation of the good work done by the entire staff during the year under report.

ACKNOWLEDGMENT

The thanks of the Committee are due to Mr. W. S. Millard for his continued help in looking after the Society's interests in London.

APPENDIX TO THE HONORARY SECRETARIES' REPORT COVERING THE PERIOD JANUARY TO OCTOBER 1950

In a supplementary report the Joint Honorary Secretary drew attention to the change in the format of the *Journal* as from No. 1 of Vol. 49 issued in April 1950. The smallness of the types hitherto used for some of the more technical articles was a source of constant complaints from readers. In future all articles will be printed uniformly in large type. The alteration in the cover of the *Journal* has met with general approval.

PUBLICATIONS

Bor and Raizada's popular and well-illustrated articles on 'Some Beautiful Indian Climbers and Shrubs' which had appeared serially in the *Journal* are being published in book form and it is hoped will be available shortly. The Committee has also decided to bring out in book form Honell's paper, published in the *Journal*, on 'The Study of Indian Molluscs' and M. A. Wynter-Blyth's 'The Book of Indian Butterflies', the manuscript and plates of which are ready. The Department of Scientific Research, Government of India, has promised to assist in the latter publication and it is hoped that it will be possible to issue it shortly. Owing to the large amount of capital locked up in our previous publications, the Committee feels it necessary to move cautiously in the matter of incurring further outlay.

NATURE EDUCATION

The scheme financed by the Government of Bombay is progressing and several study sheets have been issued for the use of teachers and pupils. A large number of teachers and shool children attended the lectures and guided tours in the Museum, and attempts are being made to produce coloured film strips showing the common birds and animals for loan to schools. Several common birds mounted in portable glass cabinets have also been prepared for circulation among the primary and secondary schools of the city.

DELEGATION TO THE INTERNATIONAL ORNITHOLOGICAL CONGRESS

Mr. Sálim Ali was delegated to represent the Society at the 10th International Ornithological Congress held at Uppsala (Sweden), 10th to 17th June 1950. He left India early in May and returned on 18th September. A full report of the Congress and the field trips that followed will be presented to members in due course. In the meantime the Executive Committee wish to record their gratefulness to all those well-wishers of the Society who responded to their appeal and made it possible for the Society to be represented at this important scientific gathering, and thereby to add to its prestige abroad. The Society's gesture of participating in this international function was greatly appreciated by the permanent Executive Committee of the Congress and by the delegates of the 30 odd countries attending. It has helped to establish close ties of co-operation between ornithologists in India and abroad, and contributed its mite to the fund of international goodwill.

On behalf of the Society our delegate extended to the International Congress an invitation to hold a future meeting in India. The prospect was enthusiastically acclaimed by all the delegates. It is hoped that economic conditions will make this a practical proposition in the near future. The Society's Committee are taking up the matter with the Government of India who have, in principle, approved the idea of holding an International Ornithological Congress in this country.

WILD LIFE PRESERVATION

The Society was represented on a sub-committee of the Parks and Gardens Advisory Committee of the Government of Bombay for the drafting of a bill for the protection of wild birds and animals in Bombay State. Many members assisted our representative with useful suggestions. The final draft of the bill has been approved by the Bombay Cabinet and it was expected to be passed at the autumn session of the Legislative Assembly.

The Committee has also decided to join the International Union for the Protection of Nature with its headquarters at Brussels. An account of this important body, by Lt.-Col. R. W. Burton, will appear in our April (1951) issue.

The Jt. Honorary Secretary, Mr. Humayun Abdulali, announced the election of the following 105 members since the last meeting:

From 4th August 1949 *to 31st December* 1949

Mr. E. D. Hooper, Dhelakhat Tea Estate, Tinsukia P.O., Assam; Mrs. W. F. Rivers, Metcalfe Road, Delhi; Miss Perin J. Mistri, Bandra, Bombay; Mr. P. R. Sen, Under-Secretary, Labour Dept., Patna; Sub-Divisional Forest Officer, Banaskanta, Palanpur P.O.; Conservator of Forests, Utilization & Engineering Circle, Poona; Mr. N. Rama Row, Bombay; The Principal, Sree Narayana College, Quilon; Mrs. Camar Tyabjee, Hyderabad (Dn); Wing-Commander Sardar

Surjit Singh Majithia, Simla East; Mrs. J. H. Barker, Kathgodam P.O., Naini Tal; Sub-Divisional Forest Officer, Sabarkantha Division, Himmatnagar; Sub-Divisional Forest Officer, Utilization and Industries, Poona; Divisional Forest Officer, East Khandesh, Jalgaon; Divisional Forest Officer, Working Plans, Southern Circle, Belgaum; Prof. A. B. Misra, D.SC., D.Phil (Oxon), University Professor of Zoology, Benares; Divisional Forest Officer, Dharwar-Bijapur Division, Dharwar; Mr. C. Lobo, Bombay; The Siliviculturist, Bombay Province, Poona; Dr. H. J. Taylor, Wilson College, Bombay; The Raja of Dhami State, Dhami, Simla Hills; Divisional Forest Officer, Kolaba Division, Alibag; The Principal, Government Brennen College, Tellicherry; Mr. T. V. Subramaniam, Bombay; Mr. Gulam Ahmed Khan, Nawab Mansib Jung Bahadur, Hyderabad (Dn); Divisional Forest Officer, East Nasik, Nasik; The Officer-in-Charge, Naturalists' Club, Inter-Services Wing, Armed Forces Academy, Dehra Dun; Mr. L. W. Wade, Bombay; Divisional Forest Officer, Working Plans, C.C., Poona; Mr. S. R. Daver, Dy. Conservator of Forests, Bilasapur; Divisional Forest Officer, Belgaum; Lt.-Col. K. Guman Singh, Banera (Mewar); Sub-Divisional Forest Officer, Working Plans, North Eastern Circle, Nasik; The Divisional Forest Officer, North Thana, Nasik; Mr. C. R. Patterson, Rajkot; Divisional Forest Officer. West Khandesh, Dhulia; Mr. F. Haverschmidt, Paramaribo, Dutch Guiana; Mr. F. R. Goldschmidt, Bombay; Mr. G. K. Kuriyan, M.SC., F.Z.S. Krusadai Island; Mr. E. B. Rajderkar, M.SC., Bombay; Mr. P. M. Lad, I.C.S., Bombay; Mr. Sri Nath, New Delhi; Mr. Ralph Lawson, Massachusetts, U.S.A.; Mr. C. E. Underwood, Calcutta; Mr. A. D. Mukerji, Meerut; H.H. Maharaja Pratap Keshari Deo, Kalahandi State; Mr. C. V. Patel, A.R.S.M., B.S.C. (Lond.), Bombay.

From 1st January to 5th October 1950.

Miss Dorothy Carolyn Harper, Lucknow; Conservator of Forests, Research & Working Plans, Poona; Shri K. P. S. Menon, I.C.S., New Delhi; Shri H. Dayal, I.C.S., Sikkim; Rev. R. Lepour, S.J., Darjeeling; Mr. A. J. Brock, Guntur; Mr. Erach D. Avari, Darjeeling; 2/Lt. M. K. Dharmendrasingji, East Kirkee; Sjt. Vijayasinh Chimanbhai Sheth, Ahmedabad; Mr. P. I. Chacko, M.A., F.Z.S., Madras; Mr. Gerald B. Eastmure, Hoogrijan, Assam; Capt. G. A. F. Rands, Rajahmundry; Faculteit van Wiskunde en Naturwetenschap, Universiteit Van Indonesie, Bandung, Java; Dr. S. R. Savur, M.B.B.S., D.M.R., X-Ray Clinic, Bombay; Mr. Stewart Conrad Kinnersley, Amritsar; Mr. S. H. Captain, Bombay; Prof. Cha Liang Chao, Delhi University, Delhi; Sir Norman B. Kinnear, M.B.O.U., Director, British Museum (Natural History), London S.W. 7; The Principal, Jeypore College, Jeypore; Mr. Julius Nazareth, Khar, Bombay; Mr. H. Marshall, Jalpaiguri; The Conservator of Forests, Sambalpur Circle, Orissa; Mr. B. R. Halder, Calcutta; Mr. J. A. Singh, Bombay; The Forest Botanist, Dharwar; Mr. Calvin D. Wilson, Salt Lake City, U.S.A.; The Secretary, Western India Automobile Association, Bombay; Major G. W. W. Halnan, Banarhat P.O. Dooars, Bengal; Dr. C. von Wedel, Oklahoma, U.S.A.; The Conservator of Forests, Berhampur Circle, Orissa; Dr. W. K. Winterhalder, Bombay; Mr. T. A. Tobit, Bombay; Mrs. Daenne B. Natolie, New Jersey, U.S.A.; Mr. L. C. Kent-Morgan, Mudigere P.O., Chikmagalur Dist.; Mr. Gobinda Chandra Thakuria, Forest Ranger, Kaziranga; Assistant Secretary to the Government of India, Ministry of Food, New Delhi; The Principal, College of Agriculture, Dharwar; Mr. A. Zaman, I.C.S., Calcutta; Mr. E. R. Wapshare, New Hope P.O., Nilgiris; Mr. Sao Saimong, Chief Education Officer, Taunggyi, Burma; The Principal, P.E. Society's College, Aurangabad; The Principal, Thiagarajar College, Mathurai; Sri Sri Sri Jubaraj Saheb of Parlakimedi, Ootacamund; Mr. Abde A. Tyebjee, Bombay; The Librarian, Royal Forest Department, Bangkok, Siam; Mr. F. R. P. Cannan, Handi Estate, Mudigere P.O. Chikmagalur Dist.; Mr. E. S. Rose, Rozella, Ceylon; Mr. Frank M. Thomas, Bangalore; Mr. Fred Webb, Bangalore; The Silviculturist, Uttar Pradesh, Naini Tal; Dr. G. V. Desai, Poona; The Divisional Forest Officer, Rajpipla; Mr. D. S. Barron, Bombay; The Principal, Darjeeling Government College, Darjeeling; Mr. N. G. F. Graham, Sangameswarpet P.O, Chikmagalur Dist.; The Sub-Divisional Forest Officer, Gir, Amreli P.O.; The Principal, Government Arts College, Madras 2; Dr. Sohrab A. Hakim, Bombay.

BOMBAY NATURAL HISTORY SOCIETY

Dr. *INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1949* *Cr.*

EXPENDITURE	Rs a p	Rs a p
To Salaries (including Dearness Allowance)		19,844 3 0
,, Contribution to Staff Provident Fund ...		873 12 0
,, Cost of Printing, etc., of Journal ...		22,152 5 7
,, Rent		1,680 0 0
,, General Charges		845 7 10
,, Stationery and Printing (Rs. 46-2-3 on account of Wild Life Conservation Propaganda)		673 9 9
,, Postage		1,548 9 1
,, Library		333 4 4
,, Fire Insurance		150 0 0
,, Audit Fees		250 0 0
,, Bad Debts		49 14 0
,, Game Birds of India Vol. III		2,385 13 8
,, Depreciation on Furniture		144 0 0
,, Excess of Income over Expenditure transferred to Balance Sheet ...		249 10 9
Total ...		51,180 10 0

INCOME	Rs a p	Rs a p
By Subscriptions		21,442 11 7
,, Entrance Fees		1,920 0 0
,, *Sales of :*		
Journals	4,032 1 1	
Society's Publications	289 2 8	
		4,321 3 9
,, *Profits on :*		
Book of Indian Birds	1,243 15 1	
,, ,, Animals	126 7 10	
Circumventing the Mahseer and other Sporting Fish, etc.	637 8 3	
Indian Hill Birds	344 13 3	
Whistler's Popular Handbook of Indian Birds	27 10 3	
Bird Picture Postcards	15 7 3	
Calendars	2,151 4 3	
Taxidermy Work, etc.	928 13 6	
		5,475 15 8
,, *Government Grants :*		
Government of India	8,000 0 0	
,, Bombay	6,000 0 0	
		14,000 0 0
,, Interest on Investments		3,278 10 0
,, *Sundries :—*		
Advertisements	719 9 0	
Donations	22 8 0	
		742 1 0
Total ...		51,180 10 0

Game Birds of India. Vol. III

EXPENDITURE	Rs a p	Rs a p
To Stock on 1st January, 1949 Bound Copies	960 0 0	
,, Stock on 1st January, 1949 Unbound Copies	4,000 0 0	
		4,960 0 0
,, Royalties to Author		174 3 0
,, Sundry Charges—Packing, etc, ...		11 10 8
Total ...		5,145 13 8

INCOME	Rs a p	Rs a p
By Sales during the year		370 0 0
,, Stock on 31st December, 1949 Bound ...	390 0 0	
,, Stock on 31st December, 1949 Unbound...	2,000 0 0	
		2,390 0 0
,, Loss transferred to Income and Expenditure Account		2,385 13 8
Total ...		5,145 13 8

Book of Indian Birds, 4th Edition

EXPENDITURE	Rs a p	Rs a p
To Stock on 1st January, 1949		12,748 0 0
,, Royalties to Author		1,361 0 0
,, Sundry Charges—Packing, etc.... ...		323 6 9
,, Profits transferred to Income and Expenditure Account		1,243 15 1
Total ...		15,676 5 10

INCOME	Rs a p	Rs a p
By Sales during the year		7,266 5 10
,, Stock on 31st December, 1949		8,410 0 0
Total ...		15,676 5 10

Dr. *INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1949*—(continued.) *Cr.*

EXPENDITURE	Rs A P	Rs A P	INCOME	Rs A P	Rs A P
Book of Indian Animals—I Edition					
To Stock on 1st January 1949		12,602 0 0	By Sales during the year		4,141 3 7
,, Royalties to Author		265 0 0	,, Stock on 31st December, 1949		9,044 0 0
,, Sundry Charges—Packing, etc.		191 11 9			
,, Profit transferred to Income and Expenditure Account		126 7 10			
Total ...		13,185 3 7	Total ...		13,185 3 7
Circumventing the Mahseer and Other Sporting Fish in India, etc.					
To Stock on 1st January 1949		3,409 0 0	By Sales during the year		2,471 11 6
,, Royalties to Author		301 8 0	,, Stock on 31st December, 1949		2,161 0 0
,, Sundry Charges—Packing etc.		281 11 3			
,, Profit transferred to Income and Expenditure Account		637 8 3			
Total ...		4,632 11 6	Total ...		4,632 11 6
Bird Picture Postcards					
To Stock on 1st January 1949		870 0 0	By Sales during the year		397 3 9
,, Sundry Charges—Packing, etc.		58 12 6	,, Stock an 31st December, 1949		547 0 0
Profit transferred to Income and Expenditure Account		15 7 3			
Total ...		944 3 9	Total ...		944 3 9
Nature Calendars					
To Stock on 1st January, 1949		158 0 0	By Sales during the year		7,112 3 6
, Cost of Printing, etc.		4,282 12 6			
, Sundry Charges—Packing, etc.		520 2 9			
,, Profit transferred to Income and Expenditure Account		2,151 4 3			
Total ...		7,112 3 6	Total ...		7,112 3 6
Indian Hill Birds					
To Cost of Books purchased		1,345 1 6	By Sales during the year		1,769 12 3
,, Sundry Expenses		95 13 6	,, Stock on 31st December, 1949		16 0 0
,, Profit transferred to Income and Expenditure Account		344 13 3			
Total ...		1,785 12 3	Total ...		1,785 12 3
Popular Handbook of Indian Birds					
To Cost of Books Purchased		164 8 6	By Sales during the year		185 4 0
,, Expenses		20 7 3	,, Stock on 31st December, 1949		27 6 0
,, Profit transferred to Income and Expenditure Account		27 10 3			
Total ...		212 10 0	Total ...		212 10 0

BOMBAY NATURAL HISTORY SOCIETY

NATURE EDUCATION SCHEME

Receipts and Payments Account for the Year ended 31st December, 1949

RECEIPTS	Rs A P	Rs A P	PAYMENTS	Rs A P	Rs A P
To *Grants from Government of Bombay* :			By Salary of Nature Education Organiser (including Dearness Allowance) :		
For 1948-49	4,600 0 0		For 1948-49	3,600 0 0	
,, 1949-50	2,390 0 0	6,990 0 0	,, 1949-50 (up to December 1949) ...	2,835 0 0	6,435 0 0
,, Plant Study Sheets—Sales		146 6 0	,, Postage		98 1 9
,, Balance—Advanced out of Society's Funds		52 10 3	,, General Expenses (Stationery, Conveyance, etc.)		93 7 6
			,, Cost of Plant Study Sheets		422 8 0
			,, Scientific Instruments		29 11 6
			,, Furniture		110 3 6
Total ...		7,189 0 3	Total ...		7,189 0 3

BOMBAY, *24th May, 1950*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants and Auditors

BOMBAY NATURAL HISTORY SOCIETY

BALANCE SHEET AS AT 31st DECEMBER, 1949

LIABILITIES	Rs A P	Rs A P
Life Membership Fees:		87,430 0 0
Advance Subscriptions and Entrance Fee:		910 0 0
Sundry Creditors:		
For Printing, etc., of Journals ...	15,419 14 9	
,, *Expenses:*		
Royalties to Authors of Books ...	1,800 10 8	
Expenses (Audit Fee, Printing, and Stationery, Sales Tax, and Salaries	627 0 6	
,, *Others:*	388 1 3	
,, Donations—10th International Ornithological Congress Delegate's Fund	2,165 0 0	20,400 11 2
Surplus Account:		
Balance as per last Balance Sheet ...	33,890 11	
Add: Donations for Expenses as per last Balance Sheet transferred...	13,900 0 0	
Excess of Income over Expenditure...	249 10 9	48,040 0 8
Carried over...		1,56,780 11 10

ASSETS	Rs A P	Rs A P
Investments: At cost or market value whichever is lower:—		
Rs. 14,000 4% Bombay Port Trust Bonds.	10,780 0 0	
,, 15,000 4% Bombay Improvement Bonds ...	11,400 0 0	
,, 36,000 3% ,, Funding Loan 1966-68 ...	35,812 10 0	
,, 25,000 3% Conversion Loan 1946 ...	25,000 0 0	
,, 2,000 3% First Development Loan 1970-75 ...	1,948 12 0	
	84,941 6 0	
Rs. 92,000 (Market value at 31st Dec. 1949 was Rs. 94,530-0-0).		
£460 3% Defence Bonds	6,133 5 4	91,074 11 4
Furniture:		
As per last Balance Sheet	1,711 15 0	
Additions during the year...	673 11 3	
	2,385 10 3	
Less—Depreciation...	144 0 0	2,241 10 3
Sundry Debtors		6,469 12 9
Nature Education Scheme: (as per statement attached)		52 10 3
Advances for Publications:		
Poisonous Terrestrial Snakes of India, Burma and Ceylon (as per last Balance Sheet)	75 0 0	
Some Beautiful Indian Climbers and Shrubs:		
As per last Balance Sheet ... 4,556 4 4		
Additions during the year ... 13 15 0	4,570 3 4	
Book of Indian Butterflies (as per last Balance Sheet)	697 7 6	5,342 10 10
Carried over ...		1,05,181 7 5

BALANCE SHEET AS AT 31st DECEMBER, 1949—(*Contd.*)

LIABILITIES	Rs A P	Rs A P	ASSETS	Rs A P	Rs A P
Brought forward ...		1,56,780 11 10	Brought forward ...		1,05,181 7 5
			Stock of Books, etc., on hand:		
			(As certified by the Hon. Secretary): (At cost less depreciation):		
			Book of Indian Birds—1,625 copies ...	8,410 0 0	
			Book of Indian Animals—1,811 copies ...	9,044 0 0	
			Circumventing the Mahseer and other Sporting Fish in India—607 copies ...	2,161 0 0	
			Old Journals—12,500 copies	3,125 0 0	
			One full set of Journal series and Jackal Mask	530 0 0	
			Bird Picture Post Cards—607 Sets ...	547 0 0	
			Society's Small Publications 273 Charts...	136 8 0	
			Game Birds of India Vol. III Bound and Unbound—465 Nos.	2,390 0 0	
			Indian Hill Birds 1 Copy	16 0 0	
			Popular Handbook of Indian Birds 2 copies	27 6 0	26,386 14 0
			Cash and other Balances:		
			On hand	350 0 0	
			With the National Bank of India, Ltd., Bombay	15,907 9 1	
			With the National Bank of London, £671-12-3	8,954 13 4	
					25,212 6 5
Total ...		1,56,780 11 10	Total ...		1,56,780 11 10

Note.—A stock of valuable research collections and library volumes have not been taken into account on the Assets side of the Balance Sheet.

We have prepared the above Balance Sheet from the Books of Account maintained and from the information given to us, and have verified the Investments, and Bank Balances. In our opinion, such Balance Sheet represents a true and correct view of the State of the Society's affairs according to the best of our information and explanations given to us.

BOMBAY, *24th May, 1950.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants and Auditors.

MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD IN THE DURBAR HALL OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY, TOWN HALL, BOMBAY, ON THURSDAY THE 5th OCTOBER 1950, AT 6 P.M., WITH REV. FR. H. SANTAPAU, S.J., IN THE CHAIR.

1. The Honorary Secretaries' Report for the year ended 31st December 1949, having been circulated among members, was taken as read.

2. The Joint Honorary Secretary read a supplementary report on the activities of the Society during the current year. (*see* p. 587)

3. The statement of accounts presented by the Honorary Treasurer was approved.

4. The Committee's nominations to the Executive and Advisory Committees for 1950, as previously circulated to members, was accepted, there being no fresh nominations received.

With the termination of the formal business of the meeting Rev. Fr. H. Rafael of St. Xavier's College gave a talk on 'The Music of the Malabar Thrush' accompanied by several sound strips and records. Fr. Rafael has spent hours and days listening to the bird in its native haunts and attempting to transpose its song to musical notation. This was followed by the exhibition of two colour films by K. S. Dharmakumarsinhji of Bhavnagar showing some new aspects of the courtship display of the Lesser Florican studied by him and recorded for the first time in his paper published in the August issue of the *Journal* [**49** (2): 201-216]. His second film dealt with other birds nesting in Kathiawar.

Both the talk and the films were greatly appreciated. It is hoped that it will be possible to show the films again to members who were unable to attend this meeting.

ANNOUNCEMENTS

1. THE DELHI BIRD-WATCHING SOCIETY

At the beginning of 1950 the Delhi Bird-watching Society was started. Its main purpose is to encourage the study of birds in and around the capital city. Until recent years surprisingly little systematic bird-study had been undertaken near Delhi. Twentyfive years ago the *Journal* contained a useful survey of Delhi birds undertaken by Mr. S. Basil-Edwardes, based on careful collecting during a six-month stay in Delhi in winter. General Hutson did some energetic work during the recent war, and prepared a list of birds. More recently Mr. N. F. Frome prepared a systematic list which was published in the *Journal* (Vol. 47, p. 277, etc.). This was based on earlier publications and on observations made by himself and some of his friends.

Sir Edward Benthall and Mr. H. G. Alexander have published supplementary notes (Vol. 48, pp. 368-372).

On this basis the above Society is preparing an up-to-date list of nearly 350 species that have occurred (including a few rather doubtful observations) and they hope in the course of time to fill in a number of gaps. The status of some of the commoner birds, even, is still a matter of dispute, and sportsmen do not all agree about the status of some of the less common wildfowl. Such groups as Warblers, Pipits and even Waders have not been at all adequately observed.

Expeditions to local bird-haunts are being arranged once or twice a month and a first lecture by Dr. Dillon Ripley on the Birds of Nepal, was given to our appreciative audience of nearly fifty in the Prime Minister's House on August 7th, 1950.

The present officers of the Society are:—

Mr. Horace Alexander (Chairman); Capt. H. C. Ranald, R.N. (Hon. Treasurer); Mrs. W. F. Rivers (Hon. Secretary); Mrs. Indira Gandhi, Mr. F. C. Badhwar, Rev. J. Bishop, Mr. C. J. L. Stokoe and Maj.-Gen. H. Williams (Committee Members).

As Mrs. Rivers is leaving Delhi her place as Honorary Secretary is to be taken by Mr. L. J. Wallach.

2. THE SPORTSMEN'S CLUB OF ORISSA

We welcome the formation of this semi-scientific club. It is obviously a step in the right direction and, in the absence of a properly organised and competent Wild Life Department, should go a long way to help in tightening up the administration of the game rules and in suppressing poaching and other illegal practices detrimental to local fauna and flora.

The objects as set out in the Constitution are:

(*a*) to ensure maintenance of balance of the fauna of Orissa,
(*b*) to promote sportsmanship among members of the club,

(c) to assist members to procure arms and ammunition and preserve their trophies,
(d) to organise shooting and scientific excursions for members,
(e) to assist the authorities in the enforcement of game laws,
(f) to study the fauna of Orissa.

H.E. Janab Asaf Ali, Governor of Orissa, is Patron-in-Chief and Shri N. Senapati, I.C.S., President. With its influential Executive Committee a solid foundation seems to have been laid. It augers well for the present and future protection and conservation of the wild life of the province.

The Club has the good wishes of the Society for its prosperity and success. Its activities will be followed with hope and interest.

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The IXth International Congress of Entomology will be held in Amsterdam, August 17–24, 1951.

Enquiries regarding membership, invitations, fee, accommodation, excursions and sectional programmes should be addressed to:—Dr. J. de Wilde, Honorary General Secretary, IXth International Congress of Entomology, Physiological Laboratory, 136 Rapenburgerstraat, Amsterdam (The Netherlands).

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Editors
SÁLIM ALI, S. B. SETNA, H. SANTAPAU

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1951 Vol. 49 No. 4

JUNGLE MEMORIES

BY

Lt.-Col. E. G. Phythian-Adams, O.B.E., F.Z.S., I.A. (Retd.)

Part VIII—Some More Tigers

(*Continued from p. 426 of this volume.*)

In the first chapter of this series I have given an account of tiger shooting on foot. But there are of course other ways of bringing 'Tom Puss' to bag, and limited as my experience with these grand animals has been, the following episodes may perhaps prove of interest, and at the same time help younger sportsmen to avoid the mistakes which I have made.

When Shooting Down, Aim Low

It is well known that one is prone to miss high when firing steeply downhill. In the course of my Army training this point had been impressed on me, so that when firing at oorial below me in 1905 I made what seemed an ample allowance, but still my bullets more than once went over the animal. It was not until I read Major Gerald Burrard's interesting book *Notes on Sporting Rifles*, that I realised the cause. Not only is there the automatic lessening of the range, but still more important is the fact that when craning one's neck sufficiently to take aim, one is almost certain to take too much foresight. This of course applies however short the range may be, and it was forcibly brought home to me during my first beat for tiger in 1908.

I was camped at the time at Sirpur in the Raipur jungles, in company with that grand old sportsman L., the D.F.O. Buffalo calves were tied up every night, but it was not until 5 days had elapsed that a kill was reported about 7 miles away. It took some time to

JUL 25 1951

collect the beaters, so it was not till 1.30 p.m. that I was able to start on L.'s elephant—he very sportingly refused to come himself, knowing (as I afterwards discovered) that it was a one-gun beat. I was in my machan by 4 p.m. but some time elapsed before the stops were posted and the beaters in position. It was the middle of the hot weather and the heat was terrific; my rifle, exposed as it was to the direct rays of the sun in my shadeless tree, became so hot that when the beat began I changed the cartridges as a precaution, fearing that if overheated they would shoot high. Not long after a 4-horned antelope appeared from behind me, and for some unknown reason dashed towards the beaters. I was wondering what on earth it was doing when I heard steps in the dead leaves in front, so got ready. The tiger came out at a slow walk about 40 yards away, and as he momentarily passed out of sight behind a tree I raised my rifle. He re-appeared not 15 yards off on my right and I fired and missed him clean, seeing the bullet hit the ground over his back. He stood for a second with ears pricked looking very astonished and then moved on again, still at the same pace. Recollecting that I was shooting down, I took care to aim much lower with my left barrel, and the bullet catching him fair on the shoulder knocked him over. For a few seconds he lay still, then got up, and falling and rising again covered some 30 yards, in his rage tearing up the ground and biting at the bushes, then collapsed. Meanwhile I had hurriedly reloaded (a slow business with an under-lever hammer weapon) and as he was making off took a hurried snapshot, but I was excited and far from steady and the bullet merely hit him on the foot. Then as he lay still I gave him one through the heart to make sure, but it was unnecessary. The rifle used was a No. 2 Express firing low pressure cordite and a nickel-base pure lead bullet of 480 grs.—no better rifle, even today, can be found for tiger and panther, but unfortunately the cartridges are hard to come by.

The moral of this story is of course that however close the range, when shooting steeply down one must aim low, for the reason already given. A brother officer with whom I compared notes had an exactly similar experience with a panther passing practically under his machan, both his bullets going over. But his animal was not so obliging as mine, for it broke into a gallop after the first shot.

MORE TIGERS THAN EXPECTED

It does not do to assume from the tracks that there is only a single tiger in a beat. Till the beaters come out one can never be sure that another will not materialise. I had an example of this in 1910 in the same jungles where I had my first tiger beat two years previously. I was again camped at Sirpur on the bank of the Mahanadi, and on the morning of March 20th my shikari Rupsingh reported a kill at Raikela. I sent out to collect beaters and at 1.20 p.m. reached the village where I found only 45 men, so had to wait some time till more arrived. When at last we reached the scene of action I found that my machan was at the foot of a rocky tree-covered slope rising on my right, while on the left in a broad tree-shaded nullah lay the pool at which the tigress had drunk quite recently; there were no other tracks.

The beat began a long way off at 3.15 p.m. and the men were not far away when there were several roars and a tiger broke out past the stops on my left—I had only a glimpse of him without the chance of a shot. The beaters were now quite close and I thought everything was over when there was a pandemonium of roars and a second tiger passed on my left at full gallop, giving such a fleeting view that again I had no time to fire. I was now certain that nothing else could possibly remain in the beat, so stood up in my machan and shouted to the shikari to collect the beaters with a view to another beat before the light failed. Suddenly I heard a dry stick snap on my right, and turning round saw the tigress passing along the hillside above me. She was only 40 yards away but there were a lot of trees and I was lucky to hit her at all. My bullet broke a hind leg and made her pause. She looked round to see where I was, then came downhill at me. On that side, owing to the slope, my machan was only some 8 feet above the ground, so my position was rather vulnerable. Luckily my second bullet caught her in the throat and brought her down, but on recovering my balance (for the recoil of the rifle had nearly knocked me over) I found that she was still breathing, so gave her a finisher with the .303.

Here was a case of more tigers than expected. The tie-up had been killed by the tigress, and no other pug marks were to be found at the water near my machan. The beat was an exceptionally long one in order to include another pool, and it was not till half the ground had been covered, that my shikari found the fresh tracks of the other two animals which had only just entered the area. So it is always well to wait till the very end of a beat before giving up hope.

I was lucky to get that tigress—I did not deserve it.

The Tiger which Looked Up

On the following day another kill was reported by my other shikari, so I sent at once to collect beaters. The D.F.O. and the Conservator had just arrived in camp, and I asked them to join me, but they were too busy, and so I was lucky enough again to have the use of L.'s elephant. I was in my machan by 1.45 p.m. but the beat did not begin till an hour later. At 3 p.m. I saw a large tiger 150 yards away going along the nullah—he made a splendid picture with his deep orange coat contrasting with the bright green of the trees as he trotted over the yellow sand. He tried the left stops but they turned him, then I saw him return and try those on the right but he could not get past. He retraced his steps and stood on the edge of the nullah bank 90 yards off. I could see only his head and neck over a fallen tree; his tongue was out and he was panting. I got my glasses on him and saw him look up at the trees all round, then he spotted me and did NOT look pleased. I realised that he would not come out, and so, small as the target was, aimed for his throat and pressed the trigger. Luckily it was a miss-fire, as I was excited and pulled off a lot. This steadied me and the bullet from my left barrel knocked him over, but he was up again at once and bolted to the left followed by two random snaps from the .303 at the moving bushes. Stops reported that he was still in the nullah, so I gave orders for the place to be ringed and sent for the elephant. As I was mounting, the tiger bolted past the stops and fearing that he would get away, I hurried after him. After about 300 yards of thick jungle, seeing no signs of him we turned back to pick up the blood trail, when the mahout suddenly spotted him in a thicket under a fallen tree about 50 yards off. As he rose I gave him a shot through the body but the elephant was too restless for a steady shot, and in fact bolted as soon as I had fired. The mahout soon got her under control, and we managed to get a bit closer again, but it was so difficult to make the tiger out in the darkness of the thicket that it took two more shots to finish him off. He was a grand beast, the largest I have shot, with a huge head and a long ruff, almost a mane. I found that my first bullet had smashed the jaw and then passed down the throat into the body; in the fury of his rage he had bitten some skin from his shoulder. While skinning him we cut out not only four bullets of mine, but also an old lead one from inside the shoulder; it was flattened out and obviously had been there some time, as it was embedded in a regular cyst. Probably it was owing to this previous wound that he looked up at the trees, an unusual habit with tigers in a beat. It was lucky that I had the use of the elephant to follow up, otherwise matters might not have ended so satisfactorily, for the tiger was far from disabled, and was, rather naturally, in an extremely bad temper.

A STICKY TIGRESS

It was in August 1929, while I was living at Lovedale in the Nilgiris, that a friend came in one day and asked for the loan of my dogs to follow up a tigress which he had wounded. It appeared that the animal had been beaten out of a *shola* and had offered a fair chance as she came uphill past O. in the open. He was positive that his first shot had hit rather far back, and that the second, fired as she topped the rise, on the shoulder or a little in front. As the rifle was a H.V. 500, it did not seem probable that she could go far, but though O. had been searching for two days, he had been unable to locate her.

It was of course little use sending my dogs alone, so I arranged to accompany O. next morning, hoping that another night would have settled the tigress if she was as badly hit as supposed, or else have given her time to get clear away. Accordingly we met next morning at Governor *shola,* where the circumstances of the case were explained to me on the ground. Heavy rain had fallen the previous night and all tracks had been washed out, so all we could do was to work in the general direction which the wounded animal might be expected to take. With the help of the dogs we searched a number of likely places but without result, and since I had other urgent work to attend to, I decided to return, leaving O. to beat certain *sholas* for pig with 18 Badagas who had joined us in the meantime. On the way back about 10.30 a.m. I passed the place where the tracks had been lost the day before, and wondered whether the tigress had not moved northeast instead of northwest as we had assumed. I determined to have a look round, so went downhill across the lower path. I soon came across a small swamp and just beyond it some very dense goatweed. It looked a likely place so I sent the dogs in and almost at once they were on to something, but whether pig or tiger I could not tell. The dogs were barking furiously and were evidently moving the animal to some extent, but the thicket was some 70 yards across and composed of dense goatweed and briars in places over one's head, so that it was impossible to see anything or even to enter. Hoping that a shot would cause the beast to break, I sent my driver round to the opposite side and he fired a round in the air from my 12 bore. But the only result was a howl from 'Chummy' and a sort of subdued growling which at last gave me a clue to the identity of the animal. There was little doubt that we had located the wounded tigress, and since obviously I could do nothing by myself, I sent the chokra off hot-foot to summon O. and the beaters. They arrived about noon and I explained the situation. I sent 'Little Boy' in again and from his barking and the growls it was obvious that the animal had not moved; the problem was how to get at it. We worked completely round the thicket but could find no entrance. We climbed trees but could see nothing. O. fired some shots with his .375 but as this produced no result, from my tree I started to search the area with S.G. from my 12 bore. I could tell pretty well where the animal was lying by the waving of the goatweed when 'Little Boy' went in; the difficulty was to calculate the height of the weeds. However after firing a number of rounds, to one of which the tigress answered, it became obvious that it was impossible to move her, so we withdrew to await the arrival of a herd of buffaloes for which I had sent. About 3 p.m. I heard a peculiar moaning noise come from the thicket, but thought no more of it at the time, though I now know that it was the tigress's death cry. Half an hour later a Forest Guard arrived with the news that no buffaloes were available, and volunteered with two others to cut a way into the thicket under close cover of our rifles. I did not much care for the idea but there seemed no alternative, and since the tigress had not moved for several hours, the chances were that she was in extremis if not already dead. First I sent the dog in again but now there were no growls in answer to his furious barking, though the tops of the goatweed continued to wave for some time after he became silent. I guessed that he was worrying the dead body which indeed proved to be the case. So, to cut a long story short, we hacked our way in and found the tigress dead with a hind foot in her mouth, and one ear badly chewed by the dog. Near by lay poor 'Chummy's' body. Some claw marks on the flank and a single fang mark in the back of the neck showed how he had met his end. He was a half-bred bull-terrier of a very impetuous disposition, and no doubt it was the sound of my driver's shot which encouraged him to rush in, as he had often done with pig. A post-mortem on the tigress revealed the somewhat surprising fact that death was due to three of my buckshot which had entered her liver. Of the original shots one had broken her right fore-leg low down, while the other after passing through the skin of the throat, had entered the left shoulder inflicting only superficial damage. Such wounds would never have deterred a more courageous animal from charging and we were certainly lucky in that respect. The rifle which O. used on the first day was a borrowed one which he had not sighted at a target, otherwise he would have been more certain of his initial shots. That seems a point worth noting—others are obvious. To the intrepid behaviour of 'Little Boy' we owed almost everything. It is true that he had previous experience with tigers, this being his fifth, whereas poor 'Chummy' had none, but imagine him going into that dense thicket again and again, during 5 hours—a stout effort indeed. Were we justified in cutting our way in? All things considered I think we were, and if a similar problem confronted me again, I should follow the same course. But it certainly was a sticky business while it lasted.

AN EASY FOLLOW-UP

Not long after the episode narrated above, another friend came in to ask my assistance in following up a tiger which he had wounded near Avalanche the day before. Accordingly we went out next morning, and leaving the car at the river crossing, proceeded about a mile uphill to the scene of action, where G. related what had occurred. While in camp at Avalanche he had heard the tiger roaring in the morning presumably to call up a mate (previously it had been seen chasing a sambar) so in the evening he sat up on a rocky spur which gave a good view of the surrounding country. Not long after he had taken up his position he saw the tiger walking along the edge of a *shola* some distance below, so hurried down and sat by an opening to await events. A sambar ponked and suddenly the tiger walked out only 15 yards away. G. sprang to his feet, and as the tiger bolted along the edge of the jungle, fired at it with his Jeffery .400. He thought that he had hit it rather far back and that his bullet had gone through diagonally to the left shoulder, which we found later was exactly the case. Next morning with his shikari he had followed up a short distance, but realising that the tiger must still be alive, very wisely decided to leave it for the time being, and to obtain the assistance of another gun. In addition to myself he had also brought K. whose first experience this was with tiger.

After appreciating the situation I sent 'Little Boy' in advance, and we three guns then entered the *shola* in line, with K. in the centre. We soon came to a spot where the wounded animal had been lying; there was still a good deal of blood on the ground in spite of rain overnight. The track now led across a nullah, so we moved round to get above it and sent the dog on again; the shola was pretty open, but there were a lot of small trees; visibility was about 40 yards. 'Little Boy' soon gave tongue, and as there was no reply, I expected to find the tiger dead, but the next sound of barking was further on, so obviously the animal was still capable of movement. Guided by the invaluable dog we pressed on, and suddenly I saw the tiger on my right front about 35 yards away, a great brindled mass between the tree trunks. There was no time to pick one's shot, so I quickly fired twice, hitting (as we afterwards found) with the first bullet through the loins and with the second in the small of the back, These anchored him and I was on the point of firing again when I remembered that it was G.'s tiger, so called to him to finish it off. Though so close he could not see the animal until he had joined me, when he put a bullet through the shoulder, while K. gave it another for luck from his Paradox.

A fine heavy male it proved to be, only half an inch under 10 feet between pegs, and with the largest lucky bones I have seen. A post-mortem showed that G.'s original bullet had entered on the right above the diaphragm and broken up on the middle of the left shoulder —it was amazing that with such a wound the animal should have survived so long, and shows what wonderful vitality a tiger possesses. Another point of interest was that the stomach contained a quantity of sambar meat, so the roars which G. had heard were certainly intended to call up a mate. And he had succeeded in doing so, for she kept hanging about while we were removing the skin, undeterred by our shots or the noise we made clearing away bushes and small trees to obtain light and space for a photo. All the time we were skinning, 'Little Boy', who had gone further on kept barking at something, but we did not pay any attention, thinking it was only at Nilgiri langurs. But when we came away we found absolutely fresh tracks of a tigress and it was no doubt at her that the dog had been barking. I ought to have realised what it was, as his bark had a special pitch when he was on to a tiger.

That we had such an easy follow-up was entirely owing to 'Little Boy'. The tiger had originally been lying concealed behind a fallen tree, and without the dog we should almost certainly have come on it at very close quarters, possibly too close to stop a charge.

A Mistake in Direction

During a recent visit to Anaikatti, the well-known shooting ground at the foot of the northern slopes of the Nilgiris, I had the curiosity to check up the bungalow book, and found that since 1926 I have stayed there over 50 times. Of recent years my visits have been principally for small game, as I seldom fire a rifle nowadays, but during the first ten years or more my chief objective was tiger. Though, however, I have beaten for them again and again, and have spent for the purpose more than I care to think about, my luck has always been out, and in all these years I have never yet brought a tiger to bag at Anaikatti, though I have fired at more than one. Something has always gone wrong: mistakes on my part, mistakes by the shikaris, bad stopping (the most fruitful cause of all), a torrential downpour at an inopportune moment, or some other cause. In fact I finally decided to give tigers there a miss, and to go after them in other parts where the *hoodoo* did not persist. A typical example of this bad luck occurred in June 1940 (my last shoot before I was recalled to Army service), but I am glad to say that though the tiger refused to give me a chance, it was shot by my driver G. who was with the beaters.

It happened like this. I had been out in the morning but had seen nothing, though I heard a tiger grunting in the direction of the

Honey Rock, a prominent feature on the hill-side in front of the bungalow. G. had gone out that way, and when we met reported that the tiger had gone uphill where his shikari was confident that it would lie up for the day. I was not very willing to try for it after so many previous fiascos due to bad bandobust. However, as the men were very keen and offered to beat without wages if I failed to get a shot, I collected about 30 beaters and started out at 10 a.m. I knew the beat well as we had done it more than once before. The men go far uphill and then beat down so as to drive the tiger below a certain rock where a number have been shot in days gone by. But I also knew that owing to increased jungle growth visibility from that post was now very restricted, and so decided to take up my position at a spot lower down the nullah. The shikaris agreed to this and after some discussion a plan of campaign was arranged, stops were posted, and I took up my position on a low rock which I screened with bushes. If all went well I should have a nice chance in the open at about 30 yards. The beat started at 11.30 a.m. and I heard two sambar break out on my right front behind some rocks where a red cloth had been put as a stop. Then I heard G. who was with the beaters, fire two shots, so knew that the tiger was hard to move. Half an hour later the tiger tried to break out on the line the sambar had taken, but was turned by the red cloth at which he roared. He should by rights then have come straight out to me, but was checked by the stop on my left persistently tapping, so returned towards the beat still roaring. At the request of the shikari G. fired another shot into the air, but the tiger was not to be deterred and broke back through the beaters. G. saw him coming straight for him so got away to one side and took a shot as he passed. The tiger rushed on into thick cover, and 10 minutes later I heard a prolonged moaning roar which I hoped was his death call. However, we could take no chances with such a bad tempered animal, so I ordered a standfast of half an hour, then collected the men and went round above the place where the tiger had last been seen. I took post higher up the nullah, and then all the men shouted and bombarded the jungle below them with stones. Nothing happened, but a few minutes later G. who had remained behind, called out that he thought he could see the tiger across the nullah. I hurried down, and advancing cautiously found it lying dead and already covered with flies—it was now 3.30 p.m. more than three hours since G. had fired. The bullet, a soft nosed .423 had entered rather far back, and after passing diagonally through the liver, was nicely mushroomed under the skin on the far side. He was a fine heavy male with rather a short tail. There was an old bullet wound on one flank, and in the nostrils were two large leeches; possibly it was the latter which caused his bad temper. It was his angry grunts as he went uphill in the morning which betrayed him, otherwise we should never have been aware of his presence. The death call was interesting; it seems to be very unusual with tigers, and I have heard it on only one other occasion, as already related in the episode of the 'Sticky Tigress'. It may perhaps be more than a coincidence that in both cases death was due to a liver shot.

One of the maxims of tiger shooting is that one should never attempt to drive a tiger over his kill, and all too late we discovered that this was exactly what we had been trying to do. For in a ravine near the foot of the hill were found the remains of a large buffalo which the tiger had killed two days before, and close to which he had been lying up. Unfortunately we knew nothing about this when arranging the beat, or I should have taken it in another direction. And that goes a long way to explain why he preferred to break back through the beaters rather than follow the more normal line. Bad luck for me certainly, but anyhow he was brought to bag which was the great thing, as he was a confirmed cattle-killer, and the villagers were glad to be relieved of his unwelcome presence.

A RAISED BACKSIGHT

It has been said with some truth that memory is like the sundial which records only the sunny hours, but this hardly applies to tiger shikar, at any rate in my own case, for the memory of tigers I have lost is as clear as that of any I have brought to bag. The following is a case in point.

My first trip to Anaikatti was in November 1925, in the palmy days when the place was full of game and tigers could always be found there. We were of course tying up, and several of our young buffaloes had been killed, but the resultant beats proved blank, as the tigers had not been properly located. In the light of further experience I am not at all sure that the shikaris were not leading us up the garden path and were simply out to make money. After all, they knew nothing about me, and in any case why kill the goose that lays the golden eggs? However that may be, the day did come when a tiger was positively located in a nullah about 5 miles to the west. We collected 16 beaters, all that were available, and reached the spot at 2.15 p.m., my post being 25 feet up a tree—far too high, but there were no branches lower convenient for the machan. The nullah to be beaten was densely bushed, and as we had so few men I sent my shotgun with them to add weight. I heard two shots fired, and shortly after the tiger appeared. He came round a bush and then stood with ears pricked, evidently uneasy but not alarmed. It was a perfect chance and I fired for his shoulder, but the only effect of my shot was that he bounded into the bushes, followed by a hurried snapshot which I saw kick up the dust behind him. I got down from my machan and we examined the place but could find no blood, and it was not till then that I noticed my backsight was at 200 instead of zero. It must have got raised in some way when I was climbing up the tree. The moral of course is that after settling into the machan, one should see not only that the rifle is loaded (which I had attended to), but also that one's sights are correct. It was entirely due to this oversight on my part that I missed such an easy chance. Of course the shikaris attributed it to bad shooting, but I was able to prove to them on a target next day that this was not the case. Attention to detail is as important in shooting as it is in business or war.

A BADLY SITED MACHAN

October 1930 found me again at Anaikatti for another 10 days shoot. This time I had brought 'Little Boy' down with me, but there were so many panthers about that when the car went up to Ooty a few days later for shandy and tappal, I sent him back, as there did not appear to be any tigers about and so it seemed unlikely that I should require his services. Bitterly was I to regret having done so. It was on the following evening that I heard a tiger calling to the west of the Honey Rock, and after dark a very frightened Badaga came in with news that he had met the animal on the short-cut path to Ebanaad—he had dropped his ghi tin and bolted. Next morning I sent two trackers to mark the tiger down while I collected beaters. About 10 a.m. a message came that the animal had been located, but on reaching the spot I found that it had moved. Its tracks led into the circular valley below the Ebanaad waterfall, a *cul-de-sac* and a favourite locality for tiger. Here we found fresh pug-marks of a tigress also, so decided to beat: My post was in a tree on the river bank near the mouth of the valley, one shikari (Chetty) and my young driver G. being posted as stops on a large rock about 100 yards up-stream on my right, while the left stop was in a tree some 70 yards uphill. The obvious line for the tigers was straight towards me along the river bank, and in that direction I had a good field of fire But my tree had a lot of upright branches which interfered with my view to the left; they were too thick to cut without making far too much noise, so I had to leave them and hope for the best. Not long after the beat started the tigress came along the bank and all would have been well had not Chetty lost his head. He jumped up and clapped his hands, turning her to my left. A spur-fowl rose noisily, then the stop uphill coughed and immediately after I saw the tigress coming down the bank on my left at a fast walk. She showed up much higher above the shrubs than I expected and her tawny coat contrasted wonderfully with the dark green around. As soon as she was clear of the bushes I swung round to fire, but my rifle came in contact with one of the upright branches and I had to raise it to clear the obstruction. By the time I was on to her again she was behind me and I had to twist round at a very awkward angle in order to fire—I felt sure that my shot was not far enough forward. She bounded off as if untouched, but I knew that I had hit her. I then got ready for the tiger, but unfortunately Chetty and the men on my right came down from their rock at my shot, and so it was able to break out on that side where I could not see it. We then went after the tigress which showed signs of being badly hit, but she had got into some very thick cover among a mass of huge boulders, and though we searched for some time we could not locate her. Bitterly did I regret the absence of 'Little Boy' who would have made all the difference. Next day I returned to Ooty to get the dog, but in the meantime heavy rain fell and the river became impassable for several days, after which all trace of the tigress was lost. Apart from the importance of having a good dog, the moral of this story is that I should have done far better on the bare rock where the shikari made such a fool of himself rather than in a tree from which I could not shoot with reasonable chance of success.

BAD STOPPING

How many chances at other tigers I have lost at Anaikatti by bad stopping I should not like to say—my diaries are full of such cases. My experiences in the Central Provinces where beating for tigers is a fine art, had taught me the importance not only of stops but of selecting the right men for the job. But when I first visited Anaikatti I found that they were looked on more or less as superfluous, and that their place could be taken, if at all, by a cloth hung over a bush. By demonstration and by persistently urging the necessity for them in time I got the shikaris to accept the idea in principle, but the number of men available for beating being limited, when it came to practice as often as not the men selected as stops were found too late to be those considered unsuitable for beating on account of infirmity or youth. Whereas of course stops should be specially chosen for their intelligence, and should know exactly what they have to do, i.e. whether they should tap the whole time or only when the tiger appears, and the amount of noise they should make. It is a very technical job indeed, and bad stops are merely a waste of time and money, besides being intensely exasperating. I remember how fed-up I got trying for a tiger at Anaikatti in June 1926. He killed 4 of my buffaloes in 9 days, and we beat for him on four separate occasions without success. On the first day he broke out on my left where there was no stop, though the shikari had been specially warned to place one there. The second day should have given me an easy chance, but the very youthful stop on my left was so frightened on seeing the tiger that he kept still and allowed it to pass under his tree, only 40 yards from me but unfortunately out of sight. What his father the shikari said to him does not bear repeating. On the third day the shikari mismanaged things, and the tiger broke back, while on the last day a stop high up on the slope above me made such a noise hurling down rocks that the tiger in panic broke out in the opposite direction and I never saw it. This was typical of beats at Anaikatti and my diaries are full of similar incidents. As trackers the men are wonderful and on a number of occasions they have marked down a tiger for me simply by following it until it lay up, without any kill having taken place. But on almost every occasion the sequel has been a mismanaged beat due to inefficient stopping. Beats are such good fun and such grand sport when things go right that one is loth to give them up, but for concrete results sitting-up would probably be more productive. Of that however I have had little experience, though I should imagine that the precautions I have suggested in the chapter on panthers would prove equally effective, provided the machan is situated high enough to evade a tiger's microscopic hearing.

(To be continued.)

SOME NOTES ON BIRDS IN LAHUL

BY

H. G. Alexander

(*With a sketch map*)

I was in Lahul from June 16th to 30th 1950, crossing the Rohtang Pass (13,050 ft.) from the Kulu Valley on the former date, and re-crossing it on the latter. Our trek took us down the Chandra valley and then up the Bhaga valley as far as the last rest house at Patsio (12,464 ft.). From there we retraced our steps. We did not attempt the short-cut from Gondla to Kyelang over the mountains. Thus, apart from the Rohtang crossing and the few hours spent at Patsio, we spent all our time at heights between 9,300 and 11,000 feet. My companions all kept a look-out for birds. Captain H. C. Ranald, R. N. in particular, often spotted things before I did and he saw one or two species that I missed.

The late Mr. Hugh Whistler published a thorough paper on The Birds of Lahul in the *Ibis*, 1925, pp. 152-208. This was the result of three visits paid by him in 1921, 1922 and 1923 at various periods between late May and early August. He covered far more ground than we did, so naturally we missed several birds that he saw. But in the area we covered, our observations were singularly parallel to his. I was not able to consult his paper till after my return, so I did not know in advance just what we were likely to find.

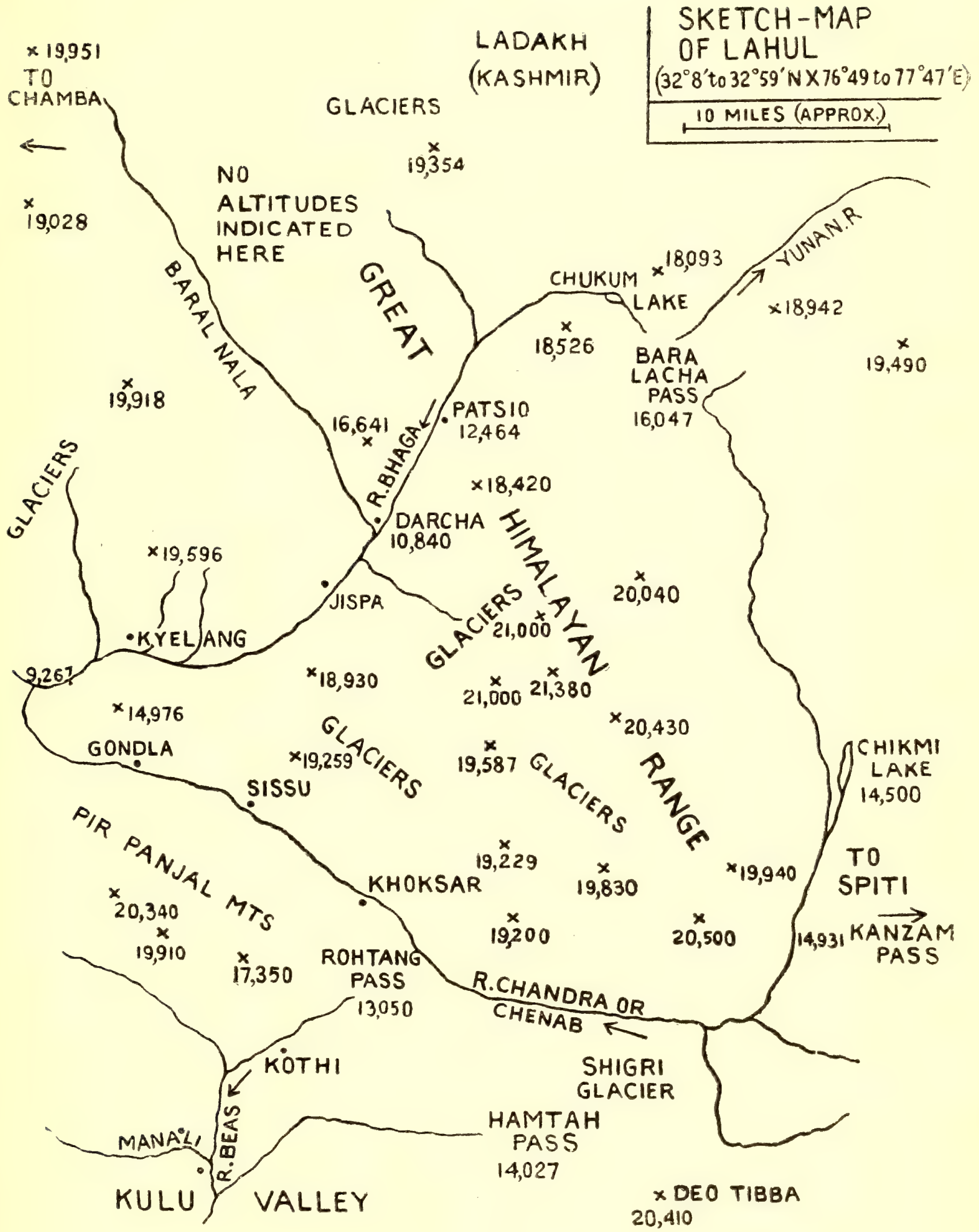
In what follows I have, in the main, only included what supplements or, in many cases, confirms, after twenty-five years, Mr. Whistler's observations.

Raven [*Corvus corax* (*tibetanus*)]. Whistler points out that the large Tibetan Raven does not breed in Lahul, but it appears with the flocks of sheep that are brought over in November and June. I was surprised to find a pair on the Kulu side of the Rohtang pass on 14th June, not higher than perhaps 11,000 feet. Next day, in the Chandra valley, I saw two pairs, both surprisingly approachable, between Khoksar and Sissu. On the 21st I heard one near Kyelang. On the return march I saw none, though I believe Captain Ranald saw one on the Rohtang pass on the 30th.

Jungle Crow (*Corvus macrorhynchos*). This bird also is uncommon in Lahul and apparently only wanders there. On the 30th I saw one close to the top of the Rohtang pass, which is probably its usual route to and from Lahul. I saw a few others in both valleys.

My observations on the two choughs fitted exactly with Whistler's remarks. The Alpine Chough (Yellow-billed, *P. graculus*) is much commoner and usually occurs higher; but *P. pyrrhocorax* is sometimes seen quite high up, at least to 12,000 feet.

The only tit I saw was *Lophophanes rufonuchalis,* the Black Tit. I saw individuals visiting nesting-holes at Kyelang and Jispa and in



SKETCH-MAP OF LAHUL
(32°8′ to 32°59′ N X 76°49 to 77°47′ E)

10 MILES (APPROX.)
× 19,951
TO CHAMBA
× 19,028
LADAKH (KASHMIR)
GLACIERS
× 19,354
NO ALTITUDES INDICATED HERE
BARAL NALA
GREAT
HIMALAYAN
RANGE
CHUKUM LAKE
× 18,093
YUNAN.R
× 18,942
× 18,526
BARA LACHA PASS 16,047
× 19,490
× 19,918
16,641 ×
R. BHAGA
PATSIO 12,464
× 18,420
GLACIERS
DARCHA 10,840
× 19,596
JISPA
GLACIERS
× 21,000
× 20,040
KYELANG
9,267
× 18,930
× 21,000
× 21,380
× 14,976
× 20,430
GONDLA
× 19,259
GLACIERS
× 19,587
GLACIERS
CHIKMI LAKE 14,500
SISSU
PIR PANJAL MTS
× 19,229
× 19,830
× 19,940
TO SPITI
KHOKSAR
× 20,340
× 19,910
× 17,350
× 19,200
× 20,500
14,931 KANZAM PASS
ROHTANG PASS 13,050
R. CHANDRA OR CHENAB
KOTHI
SHIGRI GLACIER
HAMTAH PASS 14,027
MANALI
R. BEAS
× DEO TIBBA 20,410
KULU VALLEY

the juniper wood between them. *L. melanophus,* which according to Whistler, also occurs in those woods, I did not identify.

Whistler comments on the remarkable fact that *Trochalopterum variegatum,* the Variegated Laughing-Thrush, is a common inhabitant of the willow-groves in the two valleys, and is often quite easily watched in the open. Does its presence there indicate that Lahul at one time had vegetation similar to Kulu, with oak, rhododendron, etc.? The willows are said to have been planted within the past hundred years. How did these laughing-thrushes arrive and adapt themselves to this type of habitat?

The Streaked Laughing-Thrush (*T. lineatum*) is also a plentiful species, but it chiefly haunts the lower scrub of *Berberis, Rosa,* etc. which are native species, so that its presence is not so difficult to account for.

We were lucky with Wall-Creepers of which Whistler seems to have seen very few. One was seen flitting over the Chandra river just above its junction with the Bhaga at under 9,500 feet and Captain Ranald saw a second bird the same day. This seems to be an unusually low altitude for June. A pair were visiting a cliff above the river at Patsio (12,000 ft.) perhaps collecting food for young in a nest not far away.

Himalayan Tree Creeper (*Certhia himalayana*). This species is not mentioned by Whistler. I saw one on a willow-tree above Kyelang on June 21st and another, below Kyelang, on the 27th. This latter settled on a willow-tree within a few feet of me, and I had an excellent view of its barred tail. It several times uttered a loud song, vigorous and very rapid: 'tiss, yip, yip, yip, yip, yip'. It was clearly not *C. familiaris.*

I saw all the five willow-warblers noted by Whistler. *P. affinis* I noted only along the Bhaga valley, on three or four occasions. Both this species and *P. griseolus* seem to be very silent birds. Three times I heard *P. affinis* in song, and the song is rather like a short edition of the song of the common Wren, *Troglodytes. P. griseolus* I only saw satisfactorily once, on a desolate scree two miles from Khoksar, on the 29th. I sat within range of it for twenty minutes, but it did not 'cheep a chirp'.

P. collybita was abundant all along the Bhaga valley from the junction of the rivers to Jispa, but I only once heard the familiar song in the Chandra valley. Whistler called his birds *P. c. tristis,* but Ticehurst ('Genus *Phylloscopus*', 1938) gives *P. c. sindianus* as the breeding subspecies in Lahul. The song is more 'tinny' than, and not nearly as loud as, the song of the European Chiffchaff, but it is unmistakable and just as persistent. Ticehurst says: 'Brooks noted that the call note is different from that of *tristis* and is a loud "tiss-yip".' I frequently heard a call-note that seemed identical with the usual note of *collybita,* quite distinct from the querulous single note of *tristis.* Once I saw what appeared to be a Chiffchaff constantly uttering a peculiar double note which might be Brooks's 'tiss-yip'. *P. occipitalis* is fairly common in the tree-planted parts of both valleys.

Whistler records a single *P. magnirostris* which he shot by Sissu rest-house. Curiously enough, on the 18th I heard its characteristic song and saw one in the trees at that very spot. On June 21st, between Kyelang and Jispa, I heard two in song in ravines below the path, where there were a few juniper trees for them to hide in. On the 24th one of these two was again heard singing most persistently. The five-note silver-bell-like song, descending the scale, once heard, is unforgettable. But the bird is astonishingly clever at remaining hidden in the foliage, and must, therefore, I think, be often missed by those who have not learnt its song.

The Grey-backed Shrike (*Lanius schach tephronotus*) is very common, and one can usually feel no doubt that it is of this subspecies. But I think the colour of the back and scapulars is variable and if a number were collected, possibly some would be found to come very near to *L. s. erythronotus*. More than once I saw one shoot down a hill-side as if it were a hawk, its long tail cocked up so as to be hardly visible. On one such occasion some small finches in the bushes below fled in terror.

A single White-throated Fantail Flycatcher (*Rhipidura albicollis*) was seen at Kyelang, 10,000 ft. This seems to be an unusually high elevation for the species. Whistler does not refer to it.

He records a pair of *Œnanthe pleschanka* (=*leucomela*) between the bridge and Kyelang, apparently nesting, observed on 1st June, 1921. 'This pair', he says, 'were doubtless only stragglers from the main breeding ground in Ladakh and Turkestan'. However, on the other side of the bridge, towards Gondla, I noted two males of this species in song on the 19th; both of these were barely two miles from Gondla. A good deal nearer the bridge, on the 27th, I observed two more, about a mile apart, both of them males, in song. I saw no female on either occasion and I could not find the two birds of the 19th on the 27th. But the country near the last bend of the Chandra, before it joins the Bhaga, looks very suitable for wheatears, and I think it quite likely that a small colony of the species is fully established there. Stuart Baker gives this bird the English name of Pied Wheatear (or at least Pied Chat). He calls *Œ. picata* by the same name. Perhaps Brown-winged Wheatear, or if necessary Brown-winged Pied Wheatear would be a suitable English name. For the brown in wings and tail are good diagnostic features in the male bird, separating it from several very similar wheatears whose plumage is pure black and white.

White-capped Water Redstarts (*Chaimarrhornis leucocephala*) were fairly plentiful and Indian Black Redstarts (*Phoenicurus ochruros*) extremely abundant. I did not see Güldenstadt's Redstart (*P. grandis*), which Whistler found at higher altitudes. The Blue-fronted Restart (*P. frontalis*) I saw only twice: one, a male in song, in the juniper wood between Kyelang and Jispa (11,000 ft.); the other an adult bird feeding a young one, in the open stony country at *c.* 12,000 ft., below the top of the Rohtang pass on the 30th.

The Blue-headed Robin (*Adelura coeruleocephala*) is one of the characteristic birds of Lahul. But we only saw it from near Kyelang to Jispa. I did not hear the song; but the 'tik, tik' of the male, just like an English Robin's note, was constantly heard. The pale cap of the male only looks blue when the bird is seen well below the observer (which is unusual). Otherwise it looks dull white. The underparts are not pure white, but are streaked with grey. The female could easily be mistaken for a Rufous-tailed Flycatcher.

Whistling-Thrushes (*Myophonus*) were plentiful; and I saw Blue Rock Thrushes (*Monticola solitaria*) three times.

Brown Dippers (*Cinclus pallasii*) were fairly plentiful. On the evening of the 22nd, at Patsio, just above the bridge, we watched an adult Brown Dipper feeding a young one, sometimes chasing a White-breasted Dipper (*C. cinclus*) which was resting on a stone near by, but ignoring a Hodgson's Wagtail (*Motacilla alboides*), which was also feeding at the same spot. This White-breasted Dipper was the only one of that species seen.

The only Accentor I saw was a single bird below Patsio on the 22nd; it flew out of sight and I could not find it again. Probably it was a Rufous-breasted Accentor (*A. strophiatus*), a species which Whistler found breeding in the juniper wood below Jispa.

The status of the Crossbill (*Loxia*) in Lahul is puzzling. Whistler, who did not find it, quotes Stoliczka, who visited Lahul in 1860, as stating that it is 'common in Lahul in summer'. Whistler says he made special efforts to find it but in vain. He nowhere specifically mentions, however, any visit paid to the two areas of true pine-wood, where it would be much more likely to occur than in the juniper wood. Both these areas are on north-facing slopes, and difficult of access. Stuart Baker says (Fauna, Vol. III, p. 116): 'I have in my collection a clutch of five eggs taken in Lahul, Kashmir (*sic*) at an elevation of about 12,000 feet. They were taken by natives and the details given may not be very correct, but the nest was described as a shallow cup of pine-twigs and roots lined with wool and placed on a stunted pine-tree on the outskirts of pine forest. The eggs are exactly like those of the English Crossbill'. I did not see or hear any Crossbills (I know the flying call-note well) though I was on the look-out for them. But I did not visit the pine-woods.

I had a very good view of a Spotted-winged Grosbeak (*Mycerobas carneipes*) at Jispa and heard others between Jispa and Kyelang in the juniper woods.

We saw several parties of Common Rose-finches (*Carpodacus erythrinus*), and both at Kyelang and Jispa there was a second species, slightly larger, the male a deeper red, the female a much dingier bird than the female *erythrinus*. I watched one of these females at very close quarters at Jispa. These appear to have been the Red-mantled Rose-finch (*Carpodacus rhodochlamys*). These birds were fond of raising the feathers of the crown, so that they looked to be crested. Possibly all rose-finches have this habit.

Gold-fronted Finches (*Metaponia pusilla*) and Himalayan Goldfinches (*Carduelis caniceps*) were plentiful especially in the Kyelang-Jispa area. With one party, I also saw a pair of Himalayan Greenfinches (*Hypacanthis spinoides*) not far from Kyelang. Whistler's only definite record of this species was of a single bird at Kyelang.

Sparrows (*P. domesticus*) were fairly common at Kyelang, but I saw none in the Chandra valley.

Fringillauda nemoricola, Stoliczka's Mountain-Finch—if that is the correct English name for it—(cannot the whole species be called the Plain Mountain Finch?) was plentiful. Large flocks, parties and pairs were observed in the more barren, stony areas. At Patsio they were specially plentiful; and here I had good views of two Brandt's Snow-Finches (*F. brandti*), on the morning of the 23rd. This is lower than their usual altitude.

Meadow Buntings (*Emberiza cia*) were plentiful. One day I noticed one sitting on a wall that seemed to have a broad black patch on its breast. After watching it in perplexity for some time I realised that the breeze had ruffled its feathers, so that I was seeing the base of all the breast-feathers. This is, perhaps, a rather good illustration of the kind of circumstance that leads observers to report birds seen with a colour scheme that does not fit any known species.

There were colonies of House Martins, Crag Martins and Swifts in both valleys. But I should not describe any of these species as 'very common' to-day, the description applied by Whistler to the Swift. All are fairly common.

The three wagtails noted by Whistler--Hodgson's Pied, Grey (*M. cinerea*) and Yellow-headed (*M. citreola*)—were all seen Hodgson's was noted up to 12,000 feet. Yellow-headed was only seen in two or three places.

The only pipits I saw were Hodgson's Pipits (*Anthus roseatus*) which were plentiful near the top of the Rohtang pass (12-13,000 feet). On June 30th I watched some in beautiful plumage with delicate pink on the throat. They were very tame. This also was the only place where I saw Horned Larks (*Otocorys alpestris*). The song uttered on the ground was a good deal richer than Whistler's 'short and insignificant' would suggest. Skylarks (presumably *Alauda gulgula*) I only heard and saw in the lower parts of the Chandra valley, between Sissu and the junction of the rivers.

There was a hoopoe at Sissu (10,000 ft.) both on the 18th and the 29th.

Lämmergeiers (*Gypaëtus barbatur*) were plentiful, and I think Griffon Vultures (*Gyps himalayensis*) must have increased in the past twenty-five years, as I believe they have done in other parts of the Himalayas. A little before sunset, at Patsio on the 22nd, we were watching Griffons and Lämmergeiers circling round a cliff-face, in the strong slanting sunlight, when I noticed an almost black bird amongst them. I watched it for some time and whichever way it turned in the sunlight, its plumage, both above and below, remained dark. I again saw one, in almost exactly similar conditions of light, soaring above Khoksar in the evening sunshine on the 29th. This, if anything, looked even blacker above and below. Both were undoubtedly vultures, not eagles. I can only conclude that they were both *Ægypius monachus*. I saw no eagle in Lahul. One or two kites were seen between Khoksar and Sissu. I took them to be *Milvus m. migrans*, but I suppose *M. m. lineatus* is a possibility. I saw Sparrow-Hawks twice, one soaring over Kyelang before sunset on the

24th and one that dashed close past me while I was watching a Brown-winged Wheatear on the 27th. I had a moment's fear for the wheatear, but it disappeared among the rocks in time. Kestrels were not uncommon.

Blue Rock-Pigeons (*Columba livia*) were plentiful and tame, Snow Pigeons (*C. leuconota*) occasional, usually seen in deep gorges. Captain Ranald probably saw one or more Turkestan Rock-Pigeons (*C. rupestris*) at Patsio, but if I saw them I passed them over as Snow Pigeons. The tail-pattern is, I fancy, rather similar. I confirm Whistler's statement that 'the prevalent type (of Blue Rock Pigeon) has the lower back bluish grey concolorous with the upper back, but a few white-banded birds are to be seen'.

Rufous Turtle-Doves (*Streptopelia orientalis*) were common in cultivation. Both Captain Ranald and I saw single individuals of the Spotted Dove (*S. chinensis*) at Gondla on the 27th. This species is not in Whistler's list.

Chukors (*Alectoris graeca*) are still as plentiful as they were in Whistler's time, all the way to Patsio. Captain Ranald saw one Snow Partridge (*Lerwa lerwa*).

I thought I heard a Common Sandpiper (*Actitis hypoleucos*) on the shingle banks at Darcha, which seems probable from Whistler's report of its distribution. We frequently scanned shingle-banks for Ibis-bills (*Ibidorhyncha*) but all in vain.

HILSA FISHERIES IN THE NARBADA RIVER[1]

BY

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(*With three text figures*)

(Communicated by Dr. S. B. SETNA, F.N.I.)

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INTRODUCTION

Hilsa is noted for its valuable fisheries in the lower reaches of rivers in Bengal, eastern coast of Madras and Sind. Day (1878), who paid close attention to the spawning migrations of this fish in different Indian rivers, did not record its occurrence in any of the fluvial waters of the west coast of peninsular India. Sundara Raj (1917) concluded, therefore, that Hilsa did not occur on the west coast of India except the Indus. Later, Prashad, Hora and Nair (1940, p. 530) quoting Cuvier and Valenciennes stated that M. Dussumier had obtained the fish in Bombay. Moreover, Campbell (1877, p. 362) had also recorded a plentiful supply of Hilsa in the estuaries of the Narbada; and for the past 30 years it is imported in large quantities into Bombay where, it forms the mainstay of quality fish during the monsoon. In recent years, Prater (1940), Moses (1940 and 1942) and Pillay (1948) also referred to Hilsa fisheries in and around the Gulf of Cambay.

These observers, dealing as they did, with fisheries in general, did not pay special attention to Hilsa. Recently, the author had an opportunity to study the breeding habits and early life history of the fish in the Narbada (Kulkarni 1950). Observations made on this occasion show that this potential source of food and wealth deserves more careful attention, both from a commercial and a scientific point of view. Details of this fishery as a preliminary note to further study are given below.

Acknowledgment.—I am grateful to Dr. S. B. Setna, Director of Fisheries, Bombay, for his constant encouragement and for the facilities afforded to me for the compilation of this paper.

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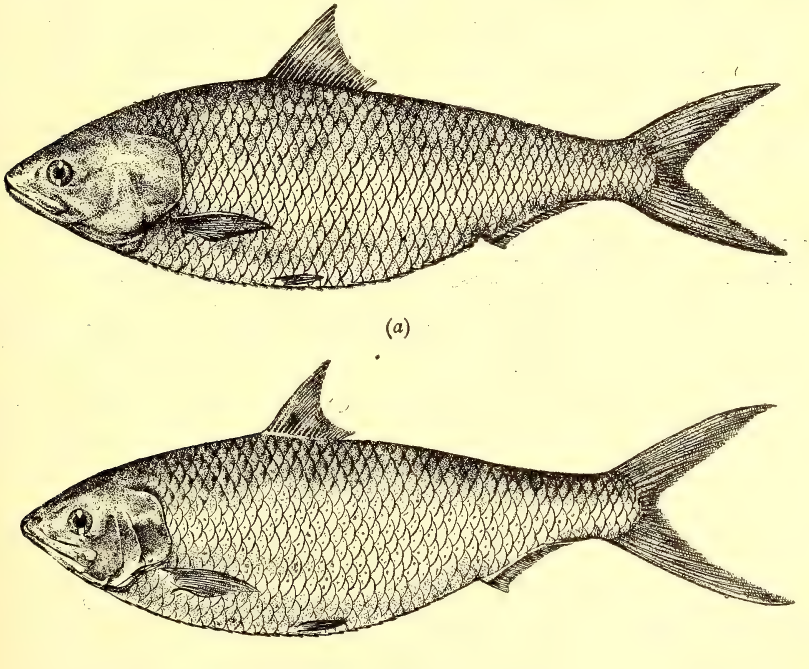
[1] Published with the kind permission of the Director of Fisheries, Bombay.

LOCAL NOMENCLATURE OF HILSA

The Hilsa is known around Bombay as 'Pala', a similar term, viz., 'Palla' being used to designate the same fish in Sind. The fish is, however, known differently around Broach where it is called 'Chaksi' or 'Chaski'. Considerable confusion arises in the common mind on account of Hilsa (*H. ilisha*) being mistaken for a similar fish, *Hilsa toli,* both of which occur in the same areas. Even scientifically, the differences, according to Day (1889) are not very pronounced as will be apparent from the following:—

Hilsa toli (C. and V.)	*Hilsa ilisha* (Ham.)
D–16–17.	D–18–19.
A–19–20.	A–19–22.
Ll.–39–40.	Ll.–46–49.
L. tr–13–14.	L. tr. 17–19.
Head 5 to 5¼ times in total length.	Head 4¼ to 4½ times in total length.
12–13 scutes behind the pelvics.	14–15 scutes behind the pelvics.

The illustrations in text fig. 1 (*a*) and (*b*) show that in superficial appearance both the fishes are similar and one can easily be mistaken for the other. It seems that the confusion is common even in Bengal where *Hilsa toli* is known as Chandana Hilsa (Hora and Nair 1940*b*). *H. toli* is known as 'bhing' around Bombay and 'modar' at Broach. The


(*a*)

(*b*)

Text fig. No. 1: (*a*) *Hilsa ilisha* (Ham.) 2 × ; (*b*) *Hilsa toli* (C. & V.) 2 ×

local names of these two fish are thus quite distinct; yet, the similarity of form and appearance leads to considerable confusion, in less critical minds, so much so that in Broach, the names 'chaksi' and 'medar' are sometimes used—indiscriminately. Consistency in the use of the names is lax. Another anomaly noted in the same area (Broach) is that instead of using the name 'chaksi' for both sexes of Hilsa, only gravid Hilsa is called chaksi and the male is termed 'palva' for trade purposes. Even a male 'bhing' or a small size non-gravid female 'bhing' is classed as Palva. If a specimen is less than 6 ins., whether of Palla or Bhing it is known as Palvi or Palavdi.

Pillay (1948, p. 58) records 'palwa' as the local name of *H. ilisha* and 'choksi' (= chaksi) as that of *H. toli* in the Kodinar-Madhwad area. Moses (1940), on the other hand, mentions 'palwa' as the local name of *Clupea toli* (= *H. toli*) and 'modar' as that of *H. ilisha* at Baroda. My own examination of specimens obtained from Madhwad establishes beyond doubt that the fish known as 'palwa' in Kodinar-Madhwad area is *H. toli* and the 'chaksi' as *H. ilisha.* Inquiries made with the importers of fish to Bombay from Kodinar area also confirm these findings. This brings to mind the fact that observations made by Pillay (1948) regarding 'palwa' taking it as *H. ilisha,* including the statistical figures recorded by him (loc. cit. pp. 58-61), relate in fact to *H. toli* and those for his 'choksi' are for *H. ilisha.*

The local names of this fish are thus confusing and much reliance cannot be placed on the terms used by local fishermen without actual examination of the specimens. These discrepancies are detailed here, as otherwise scientific workers are apt to be misled by accepting reports from less scrutinizing persons particularly because of the close similarity of form and habitat of the two fishes concerned.

In order to facilitate field identification of specimens a rough field key is furnished hereunder:—

		H. toli	*H. ilisha*
Scales	...	Large (Ll. 39–40).	Small (Ll. 46–49).
Head	...	About 1/5 total length.	About 1/4 total length.
Dorsal fin	...	Upper margin distinctly concave.	Slightly concave.
Tail	...	Long caudal lobes (almost equal to the length of the head).	Short caudal lobes (shorter than the length of the head).

Generally, the term Hilsa denotes *H. ilisha* in the entire north-eastern India as well as in scientific literature, unless stated otherwise. This usage of terms is also followed in this paper.

DISTRIBUTION OF HILSA ON THE WEST COAST

The references quoted earlier show that the occurrence of Hilsa in the Narbada as well as around Bombay is known for over a century, though in the intervening period some of the authors were not aware of it. Recent observations have shown that the distribution of the fish is not limited to this region only but extends over a much wider area along the coast. Its occurrence on the Kathiawar coast (Pillay, 1948), in the Purna river near Navsari, (Moses, 1942) and the Ulhas near Bassein (Kulkarni, 1950) has already been recorded. Further investigations have located this fish in the estuary of the Savitri river near Bankot about 70 miles south of Bombay, as well as in the estuary of the Kali river near Karwar. Chacko and Ganapathi (1949) record its occurrence on the Malabar coast also. This indicates that although there is no record from rivers in the intervening areas it may be assumed that the distribution extends definitely up to Malabar coast and may extend even further south.

Pillay's record of Hilsa fishery off the coast of Kodinar (op. cit.) as well as the occasional occurrence of this fish in the catches of the gill nets of the fishermen of Bombay, fishing about 10 to 15 miles away from the coast, in December and January, lend additional support to the assumption that Hilsa inhabit the offshore areas. However, whether on the west coast, Hilsa sojourns in the estuaries for two years in the same manner as it does, as stated by Sundara Raj (1937) in case of the estuaries on the east coast of Madras, is yet to be determined.

Another observation recorded was that though the river Tapti is so close to the Narbada and has a fairly large and perennial flow, the number of Hilsa ascending the river is very small, so much so that there is hardly any Hilsa fishery during the monsoon. Although both rivers are sufficiently wide at the mouth and have a voluminous flow of water, yet very few Hilsa are found in the Tapti. These rivers thus afford an excellent venue to determine the possibility of homing instinct in Hilsa as also to study the requirements of a successful run of Hilsa by a comparison of the conditions obtaining in these two sheets of water.

MIGRATION OF HILSA IN THE NARBADA

Recent observations indicate that though Hilsa has been found to occur generally in the Gulf of Cambay as well as the coastal areas, it is abundant only in the River Narbada. The river being the largest on the west coast after the Indus, is by far the best haven for Hilsa on this coast. It is, therefore, worthwhile to recount a few particulars of this river.

The Narbada has a total length of about 800 miles and has its origin in the Amarkantak Hills in the Bilaspur District of C.P. (Madhya Pradesh). It drains an area of about 36,400 sq. miles and flowing between the ranges of the Vindhya and the Satpura Hills finally debouches into the Gulf of Cambay. The only important town near its mouth is Broach which is 200 miles north of Bombay. According to Campbell (op. cit.), the discharge of the river in times of maximum floods is of about two and a half million c.ft. per second. To give some idea of the volume of water flowing down the Narbada, it has been estimated that in a season with average rainfall of 36 inches, a lake 324 sq. miles in area and 100 feet deep would be required to receive its waters. The total quantity of water is also estimated to be about $\frac{1}{8}$ the capacity of the Gulf of Cambay. In fair weather the velocity of the river water near Broach is 1.25 ft. per second or a little less than a mile per hour. The width of the river is about a mile near Broach, the course thereafter widening into an estuary whose shores where they fall away into the gulf area are more than 13 miles apart. Nevertheless, the estuarine area is rather limited when compared with the extensive estuarine area of the Ganges, Indus etc. It can, however, be said that the Gulf of

Cambay itself is a vast estuary owing to such rivers as the Sabarmati, Mahi, Tapti, etc., emptying into the Gulf, in addition to the Narbada.

The migration of Hilsa in this river as stated by the author (1950) commences generally in July when the first floods occur in this area and continues up to middle of September. The ascent of the fish in the river does not, however, extend over a long distance, probably on account of the course of the river being rather steep, passing as it does through hilll ranges of both the Vindhya and the Satpuras. The upstream limit of the ascent known so far is a series of rapids from Garudeshwar to Gora and Makhadi villages about 100 miles from the sea, which marks the lower or westward limit of steep hill tracts over which the river flows with considerable rapidity during the monsoon. The range of migration of the fish is thus limited to the lower reaches of the river and is certainly short as compared with the extensive tracts travelled by the fish in the Indus, Ganges etc.

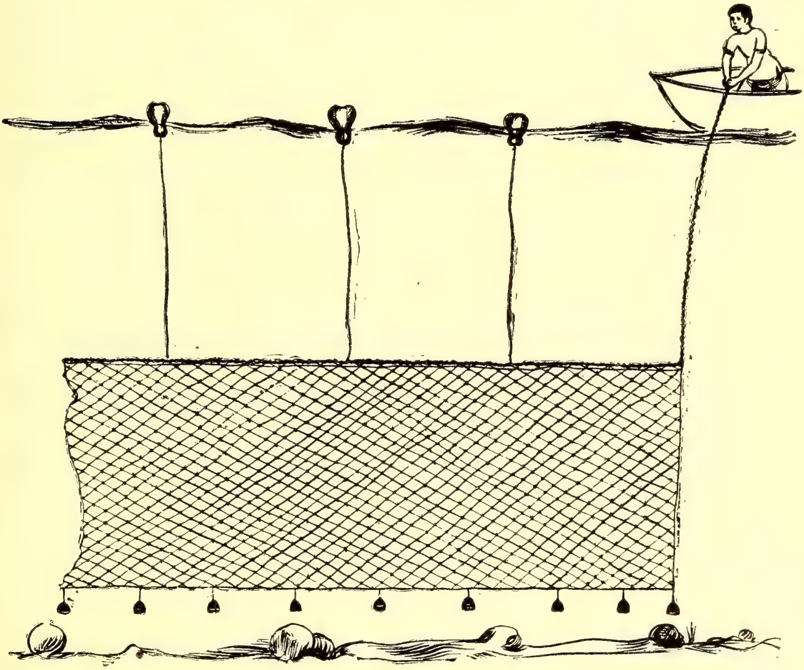
The extreme seaward point where shoals of Hilsa are sighted during their migrations and are sought for by the fishermen, is the village of Bhadbhoot about 18 miles downstream of Broach. The major portion of fishing is done, however, near the town of Broach which commands a large fishermen population hailing from the neighbouring hamlets of Hansot, Vyajalpur, Maktanpore etc. There are twenty other villages along the up-stream course of the river which undertake Hilsa fishing in the season, Jhanore being the last important fishing village.

The lunar periodicity in the ascent of Hilsa in the Narbada, has already been elucidated by the author (1950) Fish is caught on a commercial scale only during spring tide especially from the 12th day of each lunar fortnight up to the first or second day after full moon and new moon. Furthermore, it has been observed that even during the spring tide days, the catches are at their maximum during the high water period. This indicates that the duration represents the peak period of movement of Hilsa and the netting operations become more fruitful during this time only. Prospects of fishing after the spring tide are so meagre that fishermen suspend fishing during neap tide and utilize the time in mending nets and repairing boats.

Another interesting aspect of the migration of Hilsa in the Narbada is the appearance of a small run after the normal monsoon run, which begins in March and continues up to the middle of April. This run being small, fish caught around Broach are consumed locally. Whether the run really ceases after April or continues unnoticed and develops into a major run in July and August has yet to be determined. It may be mentioned, however, that this run is similar to the small run of Hilsa which occurs in the Indus and the Irravadi in March and April (Day 1873, p. 23). The cause of this run in these large rivers is attributed by Day (loc. cit.) to the melting of snow in summer in their upper reaches causing a minor flood. Hora and Nair (1940) (*a*) also observed a minor peak period in the breeding of Hilsa in the Hooghly which they attributed to the flooding of the river due to the Nor'Westers. In the Narbada, however, there is no such possibility, as at no stage, the river passes through any snow clad mountains and there is not the slightest increase in the level of water in March and April.

METHODS OF HILSA FISHING IN THE NARBADA

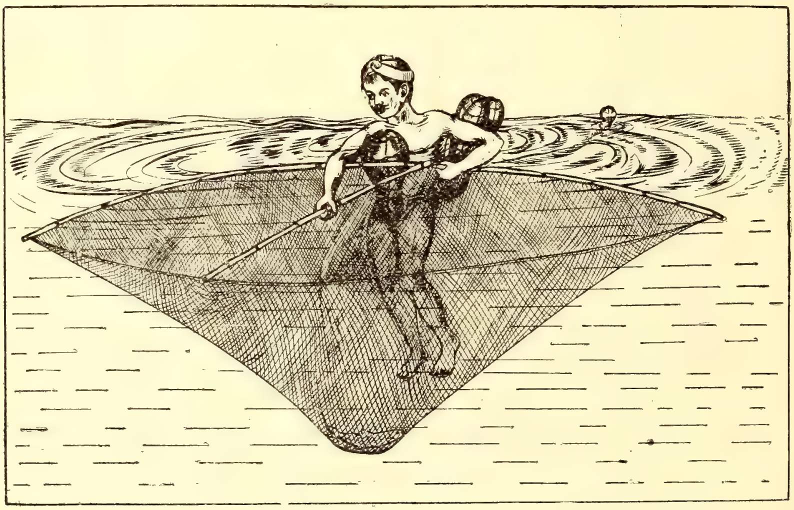
The usual gear employed for large scale capture of Hilsa in the Narbada river is sunken drift-nets. They are ordinary drift nets, but, instead of floating near the surface they are set almost near the bottom and drift at that level. Each piece is about 72 feet long and 7 feet deep. Ten or twelve such pieces are joined together end to end as a single unit and are allowed to drift as a vertical wall. The nets are generally made of twisted hemp with a mesh of 5″ (stretched mesh). Triangular pieces of burnt clay with a hole in the centre or some other similar articles are tied to the lead line and used as sinkers. About 16 floats, generally made of dry gourds are tied to the cork line (head rope) to keep the entire net erect in the water. The net is similar to the 'Palwa Jal' or 'Hilsa net' described by Pillay (1948), which fishes at the surface. The position of floats on the surface gives the impression that the net is on the surface, but actually there is a long string between the floats and the net (text fig. No. 2). This length is adjusted according to the depth of water fished so that the net remains in reality near the bottom of the river. In some places the earthen sinkers dangle half a foot below the head line (foot rope), so that the chances of the net getting entangled into the bottom debris are reduced.



Text fig. No. 2: A part of Hilsa net (diagrammatic).

The boats used for the fishing are all flat bottom boats of about a ton in capacity varying from 20 to 30 feet in overall length. Each boat has a crew of three or four, one of whom is a skipper ('tindel') who manages the boat while the others operate the nets. After the net is cast, one end of it is tied to the boat which also drifts along with the net. It is paid out across the stream almost at right angles to the current so that it drifts downwards slowly and the fish swimming upstream are enmeshed in it. After about half an hour, the net is hauled up to remove the catch and is paid out again for further operations. During spring tide period, these operations are continued day and night, and are suspended only when the catches dwindle towards the end of spring tide period.

'Jamda nets'.—In addition to professional fishermen who fish with drift nets, there is another class of people, viz., 'Bhil' fishermen who catch the ascending Hilsa with small hand nets known as 'Jamda' nets. They follow the hazardous method of negotiating the flooded river on a float made of gourds or dry pumpkins and catch the fish in their purse-like hand nets. The float is known as 'ghodi' which is made by securing together three dry gourds with coir string. Two of them are tied close together on one side and the third is attached with a broad strap in between. The gourds are encased in a meshwork of coir string so that they do not slip and are less exposed to the danger of damage. A Bhil fisherman rides this float (ghody) which supports him and keeps him above the surface of the water. He can thus remain erect in the water with his hands and legs free. In his hands he holds his small 'Jamda' net which appears like an open bag (text fig. No. 3), while his legs are free to steer his course through the water. The net has an 8 ft. long slightly curved rod which forms half of the upper margin or the mouth of the net, the other half portion of the mouth being formed of only a string line. To both these portions a purse-like netting is attached which together forms a complete net. When the net is to be operated, another straight rod, 4 feet long, is attached by its proximal end to the middle of the curved rod and to its distal end the marginal string of the net is



Text fig. No. 3: The 'Jamda' net in operation (diagrammatic).

stretched and attached in bow-and-arrow fashion. When ready for use, the curved rod appears like a bow, the marginal string of the netting as the string of the bow and the straight rod takes the place of an arrow mounted on a bow as shown in the illustration (text fig. No. 3).

The fisherman carries the gear on his back, but when he jumps into the flooded river, he mounts the float and travels downstream with the net in his hands. In this manner, he drifts with the flood with the net immersed in water, the open mouth of the net facing the ascending fish. He heads forward in this way through the middle of the river, where the water is sometimes 20 to 25 feet deep. As soon as an ascending Hilsa strikes the net, he immediately lifts the net and secures the fish. In order to store the catch, a string is passed through the gill opening of the fish and kept floating in the water with the help of another small dry pumpkin tied to the other end of the string. The fisherman thus dispenses with the encumbrance of carrying his catch and keeps his hands and legs free for his job.

On the Narbada, the 'Bhil' fishermen wait on the banks for the right time of the tide—,the high tide period representing the maximum movement of the fish—and then enter the river in groups with their nets. The nets appear like bows and arrows stretched taut and give the impression of a small army invading the river which also appears tumultuous and sullen red owing to the muddy flood water flowing swiftly downwards. In the stream, they drift in a row of 8 or 10 in a line and thus cross about five miles at a time. At Jhanore, a fishing village about 12 miles east of Broach, about 100 such 'Jamdawallas' jump into the river and drift up to Nicora, another village about five miles downstream. The catches made by these nets are not large, being about 5 to 10 fish per head.

The method is certainly interesting but at the same time hazardous. It is identical with that adopted by the fishermen in Sind (Day 1873, p. 66) where they float down on a gourd or a hollow earthen pot and catch fish by purse net. Further details of this method are lacking to facilitate comparison, but in one of the methods, where an earthen pot is used as a float, a spear is used to pierce the ascending fish, according to Sebastien Manrique (as quoted by Prashad *et al* 1940).

Most of the fish caught by the professional fishermen with gill nets are gravid females heavy with roe and weighing on an average 4 lb. a piece. Their lengths vary from 17″ to 20″. The males are fewer in number and are comparatively smaller than the gravid females. The paucity of males in the catch may be explained by the possibility that the males being comparatively slender bodied are not ordinarily gilled in the nets intended for gravid females which are heavily built. This assumption is supported by the observation that the 'Jamda' net which has small meshes (2½″ stretched mesh) catches a larger number of males along with a few ripe females.

DISPOSAL AND POTENTIALITY OF THE YIELD

Fish caught by many fishermen is collected together at the landing site by merchants, who, advance money to them for nets, boats and other accessories and receive fish at a predetermined rate. Hardly 10% of fish is sold in the local market in the fresh condition. The bulk of the fish with roe is packed in wooden boxes in ice and despatched to Bombay by rail, where there is a consistent demand for it. Part of the ice required by the trade is available locally at Broach, while additional supplies are obtained from Bombay. Fish landed at centres with a limited local demand and absence of export facilities to Bombay are cured with salt. The roe is cured and marketed separately.

Collection of accurate statistics of quantities of Hilsa landed annually, has been difficult as catches of *H. ilisha* and *H. toli* are generally mixed up both at the collecting as well as consuming centres. From information gleaned from fishermen as well as from the records of fish merchants, it is possible to arrive at a rough estimate. Each boat, in a normal season of five spring tides, (from July to middle of September), it is estimated, collects about a thousand fish. The number of fishing boats in the Narbada which are annually engaged in Hilsa fisheries is about 400. Thus, the total catch of Hilsa alone in the river totals about 16,00,000 lb. per year which at the present retail rate is worth Rs. 10,00,000.

DEPLETION OF THE FISHERY

Fishermen complain of a general diminution in the catch of fish in the past few years. A possible explanation may be the intensified fishing from the increased number of boats in recent years. This naturally results in smaller catches per unit of effort. Although there are no accurate statistics to verify this presumption, observations at Broach, as well as the records of fish imported into Bombay by rail from there, do point to a definite diminution in the former catches of fish. Several factors may account for the diminished yield. It may be the result of (1) natural fluctuation in the population of the fish in the estuary or (2) a definite reduction in the rate of replenishment of the fish population due to the depletion of stock. The reduced catches might also have represented the lowest level in a period of abundance, similar to the five year cycle recorded by Hora and Nair (1940b) in respect of the Hilsa fisheries of Bengal. Statistics are necessary to show whether there is a real decline in the fisheries, requiring man's intervention for their restoration, or if it is simply a temporary natural fluctuation which will remedy itself. All explanations are bound to be merely speculative in the absence of systematic observations conducted on a scientific basis on the spot. Only then can remedial measures be suggested.

SUMMARY

Occurrence of Hilsa in the Narbada was recorded as early as 1877. Considerable confusion prevails regarding the correct identity of *Hilsa ilisha* and *H. toli* both of which are somewhat similar in appearance and habitat. Local names are also confusing at some fishing centres.

Distribution of *Hilsa ilisha* on the western coast of peninsular India extends from the Kathiawar coast in the north to the Malabar coast in the south. In the Narbada, the migration of the fish extends only up to about 80 to 100 miles upstream, few if any ascending the adjoining river Tapti.

Hilsa fishing is generally conducted in the river Narbada with sunken drift nets, but another interesting method of fishing with 'jamda' nets is practised by Bhil fishermen (aboriginal tribe) who float on dry gourds in the flooded river for hours and catch the ascending fish. Hilsa fishing constitutes a valuable source of food, most of the fish being exported to Bombay in ice during the monsoon. Depletion of the fishery due to intensive fishing is, however, feared. Without established data no satisfactory solution can be devised to counteract the problem of diminished yield. The Narbada offers a suitable venue for detailed investigation.

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THE GENUS *DIOSCOREA* IN BOMBAY STATE

BY

H. SANTAPAU, S.J.

(*With three plates*)

Whilst checking my Khandala specimens of the genus *Dioscorea* in Kew Herbarium, I had occasion to examine a large number of sheets of this genus, all of which had been carefully checked by I. H. Burkill, the joint author of 'An Account of the Genus *Dioscorea* in the East' published in Vol. 14 of the Annals of the Royal Botanic Garden, Sibpur, Calcutta. In the course of my work I invited Mr. Burkill to go through my specimens, who very kindly acceded to my request and found several species among my plants not mentioned in Cooke's Flora. On my return to India I paid special attention to *Dioscorea* and in consequence have accumulated a fair number of sheets from various parts of Bombay State.

In the field this genus is a fairly clear one, or perhaps it should be called unmistakable, even when the plant is only in leaf. When the fruits are avilable, there is no possibility of a mistake. *Dioscorea* is well represented in Bombay by a number of more or less extensive climbers with bright green leaves. In the following notes I make no claim to originality; I have made extensive use of Prain and Burkill's Account and of my own field notes; to the Bombay localities mentioned in the Account, I add those found in the collections at present in Blatter Herbarium.

Annual plants with usually very long and leafy climbing stems and usually large underground tubers. *Tubers* annual, very variable in shape, size and number per plant; some plants have very long, cylindrical tubers going deep into the soil; others have globose or depressed-globose tubers reaching very large sizes; in some cases the tubers are solitary, one for each aerial stem, in other cases there are several tubers at the base of the plant. Starch is stored in the tubers, which are usually soft; protection against the depredations of wild animals is effected either by burying the tubers deep in the soil or by poisonous chemical substances in the tubers, which then do not require deep burying.

The direction of twining is not only constant, but in the opinion of Prain and Burkill is distinctive and can be made use of for the division of the genus into sections. The length of the stem varies from but a few cms. to over 30 m.; its structure is also distinct: in some cases there are four or more wings (*D. alata*), or the stem and other parts may be armed with rather soft prickles especially in the lower parts. The leaves are all petiolate, the petioles having a fairly large pulvinus at either end; the blade is generally simple, but a number of Bombay species are 3-5 foliate. The leaf nerves are generally conspicuous on both sides and can serve for identification purposes, as the numbers are fairly constant for a given species. In the case of *D. oppositifolia* var. *dukhunensis* the leaf margins are typically hyaline and distinctive, in the other species they are plain.

Flowers are always unisexual and generally dioecious and very small; the inflorescence, however, becomes conspicuous on account of the large number of flowers produced. The colour of the flowers is not striking, green, greenish yellow, cream or rusty-red; some of our Bombay plants are noticeable on account of the large masses of creamy-white flowers. Pollination seems to be by insects, but data on this point are very scanty. The trimerous arrangement of the flowers is clear and constant; sepals 3, petals 3, stamens usually 6, in a few species stamens 3, alternating with 3 staminodes, stigmas 3 bifid. In the male flowers there is a rudimentary ovary that often is represented by a small cone or by three minute points. In the female flower there are usually 6 minute staminodes. The capsules are always composed of three carpels, each with two seeds; the seeds are wind-borne, and to that end they are helped by a fairly large wing which may go all round the seed or may only grow towards the basal side. As regards the size and shape of the capsules, there are two main types: in one of these the wings are narrow and long, so that the whole capsule is at least as long as broad or often even longer; in the other type, the wings are very broad, so that the capsule is considerably broader than long. Dehiscence takes place in two ways, according to the structure and direction of the capsule. In the section Enantiophyllum, which includes *D. oppositifolia, wallichii, alata* and *belophylla* of our Bombay species, the margin of the wing dehisces all along and the seeds glide out of the capsule; in the rest of the Bombay species, the capsule dehisces in the apical part only and being reflexed hold the seed loose until a jerk sets them free. The seeds are large for their weight, and once free, may glide for considerable distances in the breeze.

From time immemorial the *yams*, or tubers of the genus *Dioscorea*, have been used in these parts of India as articles of food; it is on record that Indian sailors carried yams in their ships during their journeys along the coast or from India to Africa, and that the Portuguese learned the value of yams for the same purpose from Indian sailors; in the 16 and 17th centuries yams were extensively sold in the Lisbon markets and were exported by sailors to America.

Chemical analysis of ten different species of Indian *Dioscorea* have yielded the following results: fats 1.02% of the dry weight; albuminoids 10.57%; soluble carbohydrates 77.01%; fibres 5.16% and ash 5.94%; these results closely resemble those obtained from the chemical analysis of the potato tuber (Hooper, in *Journ. As. Soc. Beng.*, N.S., 7: 57, 1911). A closer analysis made in the Philippine Islands by Kingman and Doryland (*Philipp. Agric. Rev.* 10: 348 1917) gave these results: moisture 38—77%; starch 15—36.36%; proteins 0.71—3.76%; various sugars about 5.5%.

Several of the Indian species contain a poisonous substance called *dioscorine;* it is bitter and behaves like a picrotoxin, causing paralysis of the central nervous system. This poison has been detected by Hooper in *D. hispida* and in lesser amounts in *D. bulbifera, pentaphylla* and *alata*. Even in the more innocuous tubers there is a substance of uncertain nature that acts as an irritant poison on the human skin, throat, etc. Perhaps for this reason the yams are used in India as a poultice to reduce swellings and also as an antidote against snake- and scorpion-bites.

The tubers of *D. hispida* and of other Indian species form an article of food in time of famine. But careful cleansing is necessary to remove the alkaloid dioscorine. For this purpose the yams are sliced or rasped, then boiled to destroy any resistance due to the vitality of the cells, and then salted, this last being done possibly to draw out the sap by osmosis; salt water from the sea is often employed for this purpose. Washing in either sea water or salted water must be carried out at least for 3 to 4 days, or if salt is not plentiful, then the yams must be washed in running water for a much longer period, or if running water is not available, then numerous changes of still water for a long period are sufficient. A simple test to know if the washing is complete is to burn a slice of the yam: if it burns quietly, it is safe to eat; but if it 'writhes' as it burns, it is a sign that the washing is not complete. This writhing is probably due to the presence of the poisonous alkaloid that swells considerably at high temperature.

Prain and Burkill, speaking of *D. pentaphylla*, loc. cit. p. 167, write: 'Dymock states that the flowers are eaten, but no one has confirmed this remarkable statement, and the word 'flowers' is perhaps a *lapsus calami* for bulbils.' Dymock's statement, however remarkable it may appear, I am able to substantiate from my own evidence; for over ten years I have seen my Katkari and Thakur collectors working with me in the field carefully gathering large quantities of the flowers or flower buds to be cooked and eaten as vegetables; the Thakurs of Khandala seem to appreciate such flowers rather highly.

In the following pages I have given several species not mentioned by Cooke in his Flora, and changed the names of others for reasons that will become apparent in the course of this paper.

KEY TO THE DIOSCOREAS OF BOMBAY STATE.

(*After Prain & Burkill*).

Stems climbing by twining to the left:
Male flowers with a disc; stems prickly; leaves simple; capsules broader than long; seeds winged all round ... *esculenta*.
Male flowers without a disc; leaves simple or compound; seeds winged towards the base only:
Leaves simple with a large gland at the tip ... *bulbifera*.
Leaves compound:
Stamens 6 ... *hispida*.
Stamens 3, staminodes 3:
Plant with a dense grey pubescence; simple leaves rather plentiful ... *tomentosa*.
Plant with rusty-red or dirty-white hairs; simple leaves at the most only few ... *pentaphylla*.

Stems climbing by twining to the right:
Male spikes produced among the leaves, not on special leafless branches, or near the ends in the axils of gradually diminishing leaves or of bracts; leaf base rounded; margins hyaline ... *oppositifolia* var. *dukhanens.*
Male spikes on special flowering and leafless branches:
Special flowering branches short, sometimes much shorter than the spikes themselves; capsule wings broader than long ... *wallichii.*
Special flowering branches usually longer than the leaves and much longer than the spikes:
Male spikes with zigzag axes; stems winged .. *alata.*
Male spikes not zigzag, stems not winged ... *belophylla.*

Another Key Based mainly on the Vegetative Characters of Dioscorea.

Leaves simple:
Leaves opposite:
Leaves subsagittate or subhastate ovate ... *alata.*
Leaves cordate ovate with very straight sinus ... *belophylla.*
Leaves acute or rounded at the base ... *oppositifolia.*
Leaves alternate:
Leaves usually much longer than broad:
Base rounded or subacute or subcordate ... *oppositifolia.*
Base cordate with very straight sinus ... *belophylla.*
Leaves orbicular or nearly so, about as broad as long:
Leaves 7-nerved from the base ... *wallichii.*
Leaves 9-13-nerved from the base ... *esculenta.*
Leaves 5-nerved from the base:
Stems winged ... *alata.*
Stems not winged ... *bulbifera.*
Leaves compound:
Leaves 3-foliate, glabrous or nearly so when old ... *hispida.*
Leaves 3- and 5-foliate mixed; glabrous or nearly so when old ... *pentaphylla.*
Leaves 5-foliate below, simple above; lower surface persistently white-tomentose .. *tomentosa.*

Note.—There is great variability in the arrangement and division of the leaves, opposite and alternate being present on the same plant, simple and compound leaves being also found on the same plant but not intermixed; the above key applies to the *general* arrangement and structure of the leaves.

Dioscorea esculenta Burkill, in Gard. Bull. Straits Settl. 1: 396, 1917; Fischer, 1510; Prain & Burkill, Ann. 14 (1): 80-93, tt. 35-36.

D. aculeata Linn., Herb. Amb. 23, no. 12, 1754, & Amoen. Acad. 4: 131, 1759 (non Linn., 1753); Graham, 218; Nairne, 345.

D. fasciculata Roxb., Hort. Beng. 72, 1814 & Fl. Ind. 3: 801, 1832; FBI. 6: 296, 1892; Cooke, 2: 759.

D. spinosa Roxb., ex Wall., Cat. 5103, 1830 (excl. B,C,F,G. & H); FBI. 6: 291 quoad plant. mascul.

Tuberous roots many at the end of fibrous roots, globose or elliptic or cylindrical, usually about 12 cms. long. Stems puberulous or pubescent or villous, more or less prickly especially near the base. *Leaves* alternate, cordate, membranous, up to 10 cms. long and about as broad, 9-13-nerved, acute or acuminate and mucronate, glabrous or nearly so above, sparingly covered with soft hairs beneath; petioles often with very small prickles, more or less pubescent, 5-10 cms. long. *Bulbils* none.

Male flowers in long spike-like racemes; axis of inflorescence up to 20 cms. long; bracts ovate, acuminate, scarious, 1-nerved, hairy on the back, 2.5 mm. long; pedicels up to 1.25 mm. long, pubescent. Perianth cup-shaped, pubescent without. Sepals broadly lanceolate, acute, 1.75 mm. long. Petals similar but slightly smaller. Filaments about 1 mm. long, anthers about as long, introrse. Rudimentary ovary a small cone.

Female flowers like the males, axis up to 40 cms. long; bracts ovate, acuminate, pubescent, 2 mm. long, with scarious margins; bracteoles similar to the bracts but much smaller. Sepals lanceolate-ovate, obtuse, 1.5 x 0.5 mm., pubescent outside, glabrous within. Petals similar to the sepals but more acute. Staminodes 6, minute. Stigmas as three pairs of reflexed hooks. Ovary densely pubescent. Capsule reflexed, rarely produced. Ripe seeds not seen.

Distribution: Cultivated in India and eastwards to the islands of the Pacific, northwards to Japan; grown at low altitudes, from 0 to 900 m. above sea-level. Its original country is doubtful, but seems to be the Indo-Chinese region.

Localities: Sparingly cultivated in Bombay State, but largely imported from Goa under the name of 'Goa Potato', perhaps a mistranslation of the Marathi 'Gora Alu'. Bassein, *Burkill* 16,605; Ratnagiri district, vide Prain & Burkill.

Dioscorea bulbifera Linn., Sp. Pl. 1033, 1753; Wight, Icon. t. 878; Cooke, 2: 758; Fischer, 1511; Prain & Burkill, Ann. 111-132, tt. 49-51.

D. sativa Thunb., Fl. Jap. 151, 1784; FBI. 6: 295 (excl. *D. cliffortiana*) (non Linn.).

Tuber solitary, globose to pyriform, with long roots produced above the tuber. *Stem* soft, up to 30 m. long, never prickly, cylindrical or slightly angled, glabrous. *Bulbils* many, variable in size and shape. *Leaves* alternate, simple, broadly ovate-cordate, blade up to 20 cms. diam., 5-nerved, glabrous; petiole as long as the blade or shorter, ridged at the back, glabrous.

Male flowers in long pendulous spikes, which are fascicled in the axils of leaves, or more often in those of bracts on leafless branch endings; flowers white or pale rose in colour, sweetly scented. Sepals 1.25 mm. long or longer, almost linear. Petals similar to the sepals but narrower. Stamens 6, about half as long as the perianth.

Female flowers white or greenish white, in usually solitary pendulous spikes. Perianth as in the male but shorter. Sepals linear-lanceolate, subacute, 1-1.5 mm. long; petals similar but shorter and blunter. Staminodes about ¼ as long as the perianth. Stigmas as three pairs of recurved hooks. Ovary reflexed after flowering. Capsules reflexed, straw-coloured when ripe, the wings rounded at both ends, 20-22 x 8-9 mm. Seeds winged on the basal side only, brown.

Distribution: 'Tropics of the Old World and a little beyond the tropics, from the Guinea Coast of Africa to the remotest islets of the Low Archipelago in the Pacific in association with rain forests. The African variety *anthropophagorum* has been introduced into tropical America.' (Prain & Burkill, loc. cit. p. 117). It is found from sea level to 1450 m. altit.

Localities: Konkan: Villages south of Surat, *Burkill*; South Thana, *Ryan* 11693; Bassein, *Burkill, Santapau* 7327! Elephanta Island, *Boivin* 841; Trombay, *Meebold* 8747; Kalyan, *Hooper* 23370, 34638, 34639; Panjarapura, 9 Km. E. of Kalyan, *Santapau* 225.7! Parsik Hill, *Santapau* 225.9! Tansa Lake, *Santapau* 2675! Vehar Lake, Salsette Isl., *Santapau* 10213! Andheri, *Santapau* 225.11! 965! 971! Mulgaon, Salsette Isl., *Santapau* 225.10! Bandra, *Acland* 1196! 1197! *Blatt. Herb.* 26589! W. Ghats: Mahableshwar, *Birdwood;* Matheran, *Birdwood*; Khandala, *Blatt. Herb.* 25881! *Santapau* 818! 2539! 2540! 2541! 6781! 10163! 10173! North Kanara: Between Haliyal and Yellapur, *Sedgwick* 2799! Yellapur, *Bell* 3102! Dharwar, *Young*; Belgaum, *Ritchie* 728; Londa, *Cooke*; Deccan: Nasik, *Hooper* 34466; 34467; Purandhar, *Santapau*! W. Khandesh: Akrani Plateau, *Burkill* 33233, 33360.

Dioscorea hispida Dennst., Schl. Hort. Malab. 15, 1818; Merrill, Enum. Phil. Fl. Pl. 1: 217; Fischer, 1510; Prain & Burkill, 188-202, tt. 77-78.

D. amoena Wight, Icon. t. 811, 1840 (per sphalm. pro *daemona*).

D. daemona Roxb., Hort. Beng. 72, 1814 & Fl. Ind. 3: 805, 1832; Wight, Icon. t. 811; FBI. 6: 289.

D. triphylla Linn., in Stickmann, Herb. Amb. 23, 1854, & Amoen. Acad. 4: 131, 1759 (non Linn., Sp. Pl. 1753); Graham 218; Nairne 344.

Tuber depressed-globose, often lobed, and at times very large (up to 35.5 kgs. or even more), very poisonous; roots produced above the tuber. *Stems* usually prickly, up to 8-9 mm. diam., and up to 30 m. long, at first finely pubescent, at length glabrescent. *Bulbils* not seen. *Leaves* alternate, 3-foliate; petiole up to 20 cms. long, pubescent; the middle leaflet elliptic or elliptic-oblong, acute or acuminate, 3-nerved from the base; lateral leaflets unequal-sided, 5-7-nerved, smaller than the middle one; all leaflets softly silky above when young, at length glabrescent; lower surface with glands and retaining its hairs until maturity. Petiolules about 1 cm. long, pubescent.

Male flowers fragrant, in dense paniculate spikes; axis of the spike 6-10 mm. long. Bracts subacute, shortly acuminate, pubescent; bracteole subcircular, slightly concave, hairy outside. Sepals orbicular, pubescent at the back, 0.75 mm. long and broad. Petals slightly stouter and longer, broadly ovate, glabrous. Stamens 6, 0.6 mm. long. Rudimentary ovary a minute cone.

Female flowers in elongated, simple, solitary spikes, which are up to 20 cms. long; axis pubescent; bracts triangular lanceolate, pubescent, 2-2.5 mm. long; bracteole similar, but much smaller. Sepals pubescent, ovate-lanceolate. Petals slightly smaller. Staminodes very small. Stigmas broad and short. Capsules reflexed, glabrous or nearly so when ripe, up to 45 mm. long; wings semi-elliptic or semi-ovate with a short margin. Seeds brown, winged towards the base, wings up to 27 mm. long, 9 mm. broad.

Distribution: 'Tropics of Asia in the regions of the Rain-forests or a little beyond, from India to Formosa, the Philippine islands and New Guinea'. From sea level to about 1200 m. altit.

Prain and Burkill distinguish 5 varieties, of which only var. *daemona* is found in Bombay.

Localities: S. Gujerat: Surat Dt., *Burkill;* Khandesh: Taloda, *Burkill;* Concan: Thana Dt., *Burkill;* Tungar range, 1.5 km. NW. of Brahmanpada, *Santapau* 225.5! 225.6! Ratnagiri district, *Burkill;* N. Kanara: Haliyal, *Sedgwick* 2829! without precise locality, *Burkill;* Deccan: Sinhgarh Hill, *Kulkarni, Garade, Bhide.*

Dioscorea tomentosa Koenig ex Roxb., Hort. Beng. 105, 1814; Sprengel, Pl. Pugil. Sec. 92, 1815; Heyne in Roth, Nov. Pl. Sp. 371, 1821; Roxb., Fl. Ind. 3: 805, 1832; Wight, Icon. t. 815 (descript. in p. 7 tantum partim); FBI. 6: 289; Fischer, 1511; Prain & Burkill, Ann. 156-160, tt. 56-57.

Tubers several, long, cylindrical, sometimes branched. *Stem* up to 20 m. long, sparingly prickly, when young densely white-tomentose, when old ridged near the base. *Bulbils* not seen. *Leaves* very variable, 5-foliate below, gradually passing into simple leaves near the ends of the branches; petioles up to 12 cms. long; middle leaflet largest, up to 15 × 5 cms., elliptic ovate, abruptly acuminate; upper surface more or less pubescent, lower surface densely white tomentose. Lateral leaflets smaller and more or less unequal-sided; petiolules 2-6 mm. long. Simple leaves broadly ovate or cordate, 5-7-nerved.

Male flowers in paniculate racemes; axis of inflorescence densely pubescent. Buds subglobose. Bracts ovate to broadly ovate, placed just below the flower, about 1 mm. long, densely pubescent outside, margins scarious. Bracteoles similar but smaller. Sepals pubescent outside, about 1 mm. long. Petals similar to sepals, but slightly smaller and less pubescent. Stamens 3, shorter than the sepals; staminodes 3, about as long as or a little longer than the stamens, fish-tailed at the apex. Rudimentary ovary a small three-lobed wart.

Female flowers in long simple spikes, which are solitary or two together in the axils of leaves and up to 35 cms. long and pubescent; bracts ovate, acuminate, 2 mm. long. Sepals thick, ovate. Petals thinner, smaller, ovate, subacute. Staminodes 6, small. Stigma with three pairs of short rays. Ovary 6 mm. long in flower.

Capsules up to 25 mm. long, the wings rounded at both ends, but broadening upwards, 24 × 10 mm., pubescent. Seeds winged towards the base of the loculus, 15-20 mm. long.

Distribution: South of Bombay State to Ceylon, from sea level to 1350 m. altit.

Localities: Belgaum, *Ritchie* 1238; between Belgaum and Sutgatta, *Young*.

Dioscorea pentaphylla Linn., Sp. Pl. 1032, 1753; Wight, Icon. t. 814; Dalz. & Gibs., 247: FBI. 6: 289; Cooke, 2: 757; Fischer, 1511; Prain & Burkill, Ann. 160-170, tt. 57 & 67.
D. Jacquemontii Hook. f., FBI. 6: 290, 1892.
D. triphylla Linn., Sp. Pl. 1032, 1753.

Tubers usually simple, variable in size, long. *Stems* up to 7 mm. diam., usually prickly, sparingly hairy when young, glabrous when old, up to 10 m. long. *Bulbils* many, globose or cylindrical. *Leaves* alternate, petiole up to 8 cms. long, rusty-pubescent; leaflets 3-5, the middle one longer than the rest and equal-sided; lateral leaflets unequal-sided, smaller, all pubescent or glabrous above, more pubescent and glandular beneath; petiolules rusty, not more than 5 mm. long.

Male flowers in racemes towards the ends of the branches; axis up to 3 cms. long, pubescent; bracts just below the flowers, usually broader than long; bracteoles broadly ovate to broadly lanceolate. Sepals broadly lanceolate, subacute, glabrous or pubescent outside, 1 mm. long. Petals broader, blunter and more glabrous than the sepals. Stamens 3, half as long as the sepals; staminodes 3, a little longer than the stamens, bifid or tongue-shaped at the apex. Rudimentary ovary a small cone with three scarcely separated tips.

Female flowers in pendulous spikes, which are 1-3 in leaf-axils; axis up to 25 cms. long, pubescent, angled; bracts broadly ovate, acuminate. Sepals as in the male, but more deltoid. Petals as in the male, but a little thicker. Staminodes very minute. Stigmas as three rays bifid outwards. Ovary pubescent, reflexed after pollination. Capsules up to 20 mm. long, rounded at the base, retuse at the apex, the wings semi-elliptic, up to 6 mm. broad, brown when ripe and more or less glabrous. Seeds winged only towards the base with a brown wing.

Distribution: Throughout the wetter parts of tropical Asia, and eastwards to the furthest isles of the Pacific. From sea level to 1700 m. altit.

This is a very variable plant; Prain and Burkill distinguish 16 different varieties; the following key gives the differences for common Bombay ones:

Tubers elongated to more than twice their diameter:
White hair abundant about the male flowers and present elsewhere .... *linnaei*.

White hair not abundant about the male flowers, though present:
  Bulbils not elongated like a bolster ... *jacquemontii.*
  Bulbils elongated like a bolster ... *rheedei.*
Tubers not elongated to more than twice their diameter ... *communis.*

The flower buds are collected by the Katkaris and Thakurs and used as vegetables; I have often seen my assistants in the field collecting them in large quantities to be used in curries, etc.

Localities: S. Gujerat: Surat Dt., *Burkill;* Concan: Thana Dt., Virar, *Ryan* 2346; Pelhar, *Ryan* 1261; Nagh Forest, Ryan 1209; Bassein, *Chibber, Santapau*! Mumbra, *Santapau*! Kanheri Caves, *Santapau*! Salsette Island, not common, *Santapau*! W. Ghats: Mahableshwar, *Hooper* 34608, 34609, 34610; *Birdwood; Cooke*; *R. K. Das* 34486; *Santapau*! Panchgani, *Bhide* 1120; Khandala, *Cooke*; *Gammie*; *Meebold* 8798; *Santapau* 225.1, 4, 14! 515A! 522A! 523A! 555A! 896! 1172! 1283! 2503! 2538! 2615! 5112! 10175! 10221! 10222! 10290! 10291! Purandhar, *Bhide; Santapau*! *Eklund* 268! *Leszczynski* 343! 374! Sinhgarh Hill, *Bhide;* Lanaoli, *Garade;* Between Poona and Khandala, *Jacquemont;* Between Khandala and Campoli, *Bhide* 847; Between Khandala and Carli, *Jacquemont* 568; Diva Ghat, *D. M. Patel*! N. Kanara: Yellapur, *Talbot* 1042; Tinar Ghat, *Talbot* 2622; Haliyal, *Talbot* 1978; Sanikatta, *Jevlekar;* Hattikere, *Hallberg* and *McCann* 23313! Dharwar, *Young;* W. of Dharwar, *Sedgwick* 2788! Belgaum, *Ritchie* 730! Tadas, Dharwar Dt., *Sedgwick* 1921! Amboli, *Burkill* 16985; 17026; 17039. Deccan: Kolhapur, *Acland* 1195! 1198!

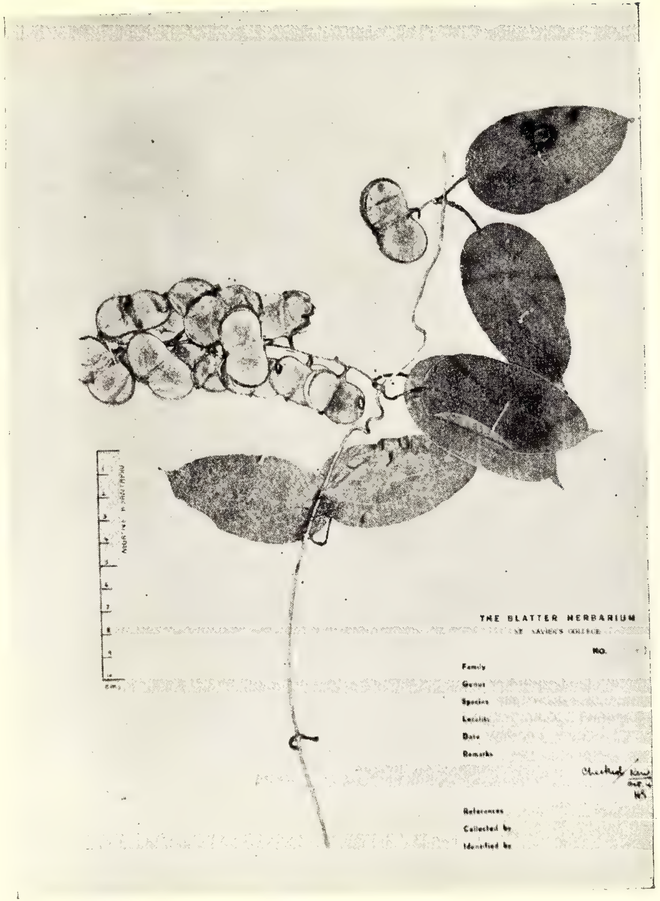
The two specimens of Sedgwick are remarkable in that the flowers are very densely tomentose, but the leaves are glabrous on both sides; they look like an intermediate stage between *D. tomentosa* and the present species.

Dioscorea oppositifolia Linn., Sp. Pl. 1033, 1753; Graham, 219; Wight, Icon. t. 813; Dalz. & Gibs., 247; FBI. 6: 292; Nairne, 344; Cooke 2: 758, Fischer, 1512; Prain & Burkill, 392-396, t. 139.

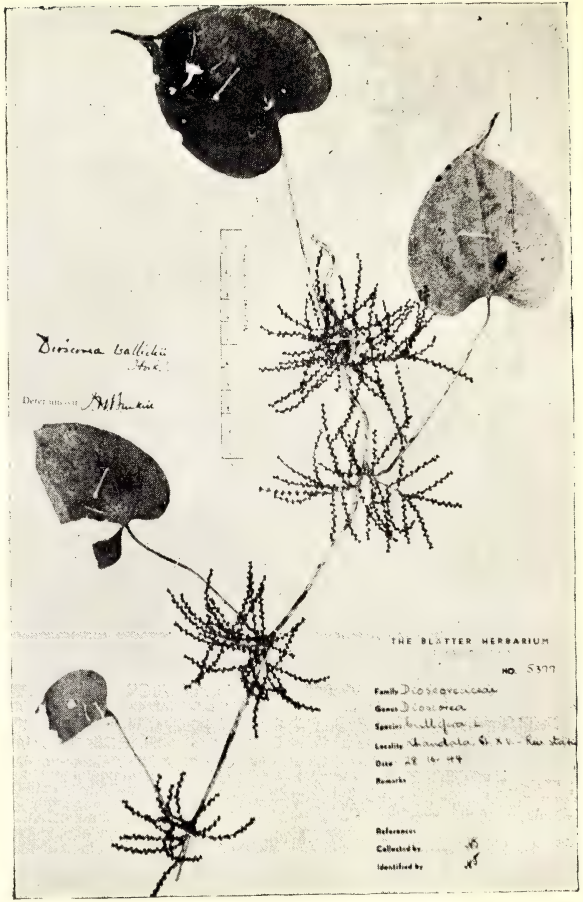
Tuber very long, cylindrical, edible. *Stem* glabrous or nearly so, up to 3-4 m. long. *Bulbils* not seen. *Leaves* alternate to opposite, simple, elliptic-obovate, acuminate, with a brown subhyaline margin, up to 12 x 7 cms., 5-7-nerved, glabrous above, glabrous or pubescent beneath; petiole up to 4 cms. long.

Male flowers in spikes which are grouped in the axils of leaves; axis of inflorescence 1-3 cms. long, glabrous or pubescent, angled. Bracts ovate-acuminate, scarious; bracteoles similar but shorter. Sepals broadly ovate, 1-1.5 mm. long. Petals almost oblong, as long as the sepals. Stamens 6. Rudimentary ovary of three very small points.

Female flowers in simple, decurved spikes, which are up to 15 cms. long and solitary, axillary. Bracts as in the male. Sepals


THE BLATTER HERBARIUM
ST. XAVIER'S COLLEGE
NO.
Family
Genus
Species
Locality
Date
Remarks
References
Collected by
Identified by

1. *Dioscorea oppositifolia* Linn.


Dioscorea wallichii Hook.
THE BLATTER HERBARIUM
NO. 5377
Family Dioscoreaceae
Genus Dioscorea
Species
Locality
Date 28 10 44
Remarks
References
Collected by
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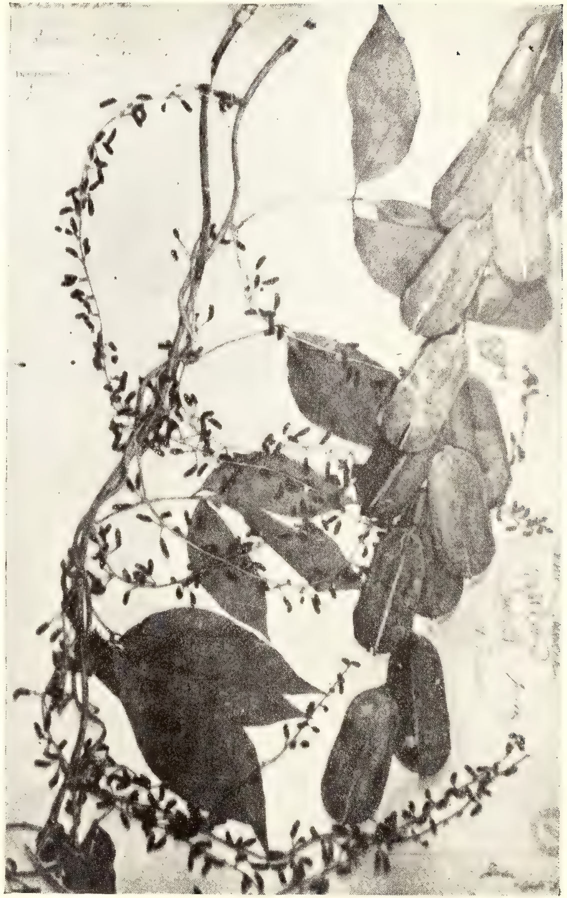
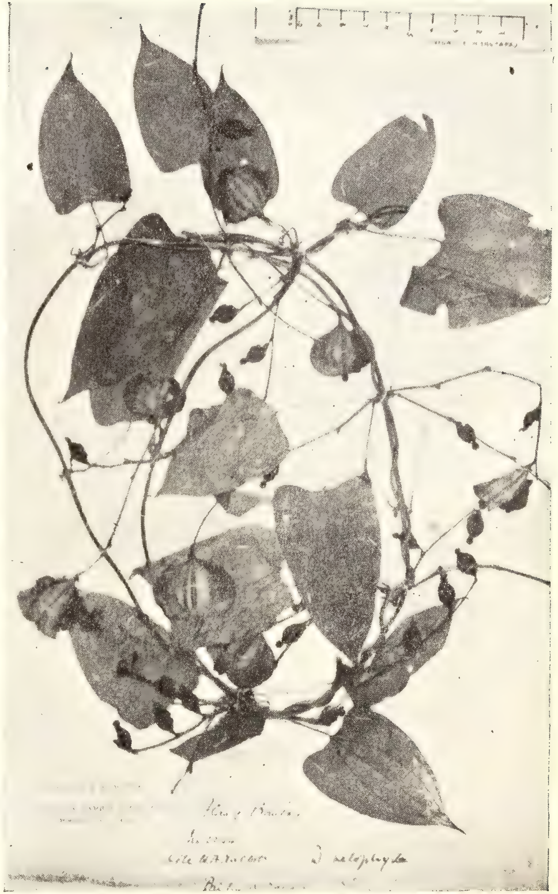
2. *Dioscorea wallichii* Hook. f.

PLATE II



2. *Dioscorea hispida* Dennst.



1. *Dioscorea belophylla* Voigt.

ovate, almost rounded, 1 mm. long. Petals smaller. Staminodes minute. Stigmas as three pairs of small hooks. Ovary at flowering time 4 mm. long; capsules with a stipe 3-4 mm. long, wings 16-24 mm. long, evenly rounded, 12-17 mm. broad. Seeds with a brown wing all round.

Distribution: 'India throughout the hills of the Deccan and in Ceylon.' Prain and Burkill distinguish 4 varieties, of which var. *dukhunensis* is the only one found in Bombay State. Typical of this variety is that usually the male flowers are on axillary spikes and the leaves are glabrous. Our Bombay variety is found from sea level to 1800 m. altit. and is rather abundant.

Localities: W. Khandesh: Akrani plateau, *Burkill* 33284; Concan: Rajaoli forest near Bassein, *Ryan* 893; Vetoli, *Ryan* 410. W. Ghats: Mahableshwar, *Graham*; Sinhgarh, *Bhide*; *Santapau* ! Panchgani, *Blatter*; Khandala, *Graham*, *Cooke*, *Garade*, *Santapau* 519! 898! 1170! 2116! 2504! 4429! 4465! 4473! 4657! 9052! 9554! 10162! 10170! 10171! 10172! Deccan: Poona, *Woodrow*; Boudhan, near Poona, *Kanitkar;* Karli, *Gammie* 15141; Malkapur, *Shevade;* N. Kanara: Karwar, *Talbot* 587, 597; *Bell* 6109! E. of Castlerock, *Burkill*; *Gamble* 15661; Birchop, *Talbot* 2127; Devimane Ghat, *Kulkarni*; Amboli, *Burkill* 16961, 16962, 16969; Devarayi, *Sedgwick* 4125! Astoli, *Sedgwick* 2549!

Dioscorea wallichii Hook. f., FBI. 6: 295, 1892; Fischer, 1512; Prain & Burkill, Ann. 281-285, t. 115.

D. aculeata Linn., Sp. Pl. 1033, 1753, quoad cit. Rheede, excl. tubercul.

Tubers 1 m. or more long. *Stems* somewhat prickly towards the base, glabrous. *Bulbils* not seen. *Leaves* alternate, cordate, acuminate, simple, up to 25 cms. diam., 7-nerved, glabrous and dark green above, glabrous, somewhat glaucous and with prominent nerves beneath; petioles about as long as or a little longer than the blade, the pulvini violet tinted.

Male flowers in spikes on short leafless branches; spikes up to 5 cms. long, solitary or paired in the axils of small bracts; axis glabrous and angled. Bracts ovate, acuminate, glabrous, 1 mm. long, red-brown. Petals similar but smaller, almost obovate. Stamens 6, shorter than the petals. Rudimentary ovary a small trifid cone.

Female flowers in decurved slender spikes, which are solitary or paired; axis straight, glabrous, angled, equalling the leaves in length. Bracts broadly ovate, acuminate, glabrous. Sepals broadly ovate, obtuse, 1 mm. long, glabrous, thick. Petals similar but smaller. Staminodes minute. Stigmas as three pairs of short, sickle-like organs. Capsules usually not more than 4-5 to each spike, glabrous, more or less glaucous, wings 20 mm. long, truncate above and below, rounded along the margins, 15-18 mm. broad. Seeds with a brown wing all around.

Distribution: India to the Sahn Plateau and Tennasserim, in moist hill forest, from sea level to 900 m. altit. Prain and Burkill distinguish two varieties, *vera* and *Christiei;* all the Bombay specimens belong to the var. *vera.*

Localities: W. Khandesh: Rapapur, *Burkill* 33239; Concan: Near Mahim, *Ryan* 20490; Bassein, very common, *Burkill* 16621; W. Ghats: Khandala, *Santapau* 3090! 5377! 9821! 9822! 10507! N. Kanara: Devarayi, *Nana* 27746! Haliyal, *Talbot* 2022; Between Poondra and Amboli, *Burkill* 16988.

Dioscorea alata Linn., Sp. Pl. 1033, 1753; Graham, 218; Wight, Icon. tt. 810, 812; Cooke, 2: 759; Fischer, 1512; Prain and Burkill, Ann. 302-342, tt. 123-125.

D. aculeata Linn., Sp. Pl. 1033, 1753, pro parte; Wight, Icon. t. 2060.

Tubers edible, very variable in shape and size, solitary. *Stems* up to 16 m. long, glabrous, winged. *Bulbils* globose or ovate, few to numerous. *Leaves* opposite, rarely alternate, in equal or unequal pairs, subsagittate or subhastate-ovate, acuminate, mucronulate, up to 15 x 14 cms., usually 5-nerved, glabrous; petioles about as long as the blade.

Male flowers rarely produced; when present, they are in spikes on leafless branches; axis of spike 12-15 mm. long, zigzag, glabrous; buds globose; bracts deltoid ovate, about 1 mm. long, acuminate; bracteoles similar but smaller. Sepals elliptic-ovate, obtuse, glabrous, 1 mm. long. Petals subspathulate, about as long as the sepals. Stamens 6, 0.5 mm. long. Rudimentary ovary a small cone.

Female flowers in spikes longer than the leaves, rarely produced; bracts ovate, acute, 2 mm. long, scarious; bracteole similar but smaller. Sepals broadly ovate, acuminate, 2 x 1.5 mm. Petals shorter, obovate, thick. Staminodes minute. Stigmas as three pairs of sickle-shaped hooks. Capsules 20 mm. long, the wings broader than semicircular, 13 mm. broad at the middle, drawn into a 2 mm. long stipe at the base, glabrous, reddish-brown when dry. Seeds winged all round.

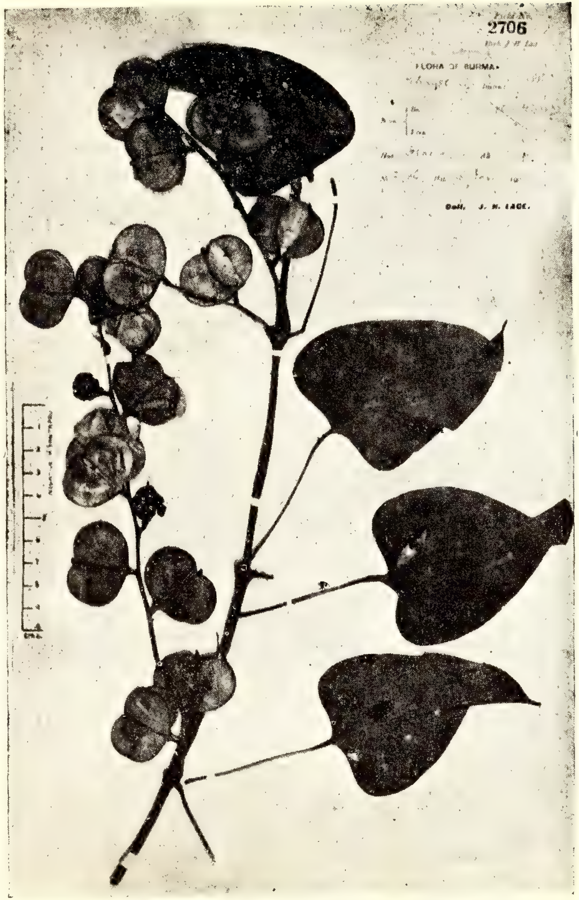
Cultivated in the tropics. In Bombay it is found from Nadiad in Khaira Dt., along the coastal tract west of the Ghats down to Goa.

Dioscorea belophylla Voigt, Hort. Sub. Calc. 653, 1845; Fischer, 1512; Prain and Burkill, Ann. 348-352, t. 127.

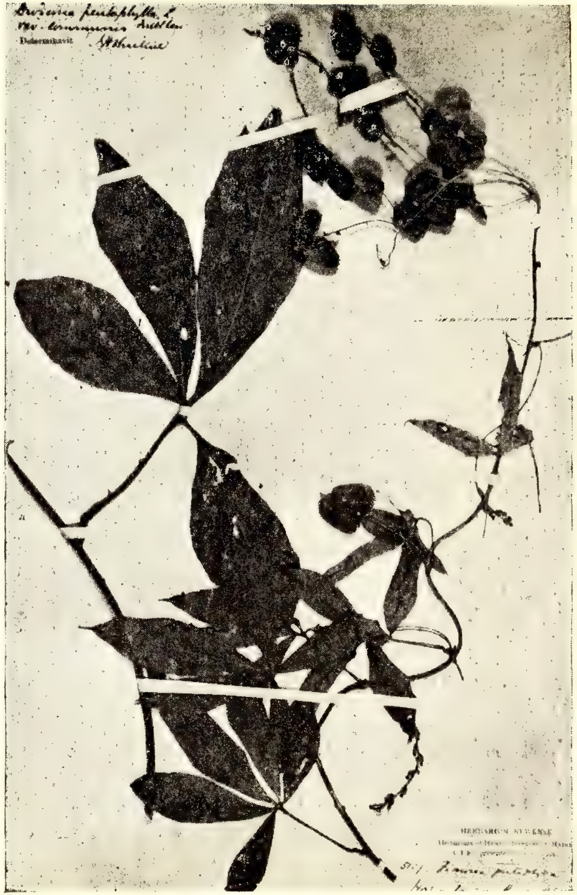
D. glabra Hook. f., FBI. 6: 294, 1892, pro parte.

Tubers deep in the soil, 1-3 in number, edible. *Stems* unarmed, often ridged, up to 4 mm. diam. *Bulbils* abundant. *Leaves* simple, sagittate-ovate or the upper cordate-ovate, the sides of the basal sinus very straight, the lower often alternate, the upper usually opposite, 5-nerved, glabrous; petiole up to 11 cms. long.

Male flowers in spikes on special leafless branches; axis glabrous, ridged, up to 30 mm. long. Bracts below the spikes ovate-acuminate, glabrous, bracts below the flowers ovate, acute, glabrous, 0.5 mm. long, scarious; bracteoles similar but smaller. Sepals obovate, incurved, obtuse, 1.25 mm. long. Petals similar but shorter. Stamens


2706
FLORA OF BURMA.
Coll. J. H. LACE.

1. *Dioscorea alata* Linn.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2. *Dioscorea pentaphylla* Linn.

6, a little shorter than the petals. Rudimentary ovary a cone with three points.

Female flowers in short solitary spikes; axis glabrous, bracts long-deltoid. Sepals broadly ovate, 1 mm. long, thick. Petals similar but shorter. Staminodes minute. Stigmas as three pairs of sickle-like organs. Capsules with a stipe 3 mm. long, the wings 15-18 mm. long, evenly rounded, 11-15 mm. broad. Seeds with a red-brown wing all around.

Distribution: Endemic in India and Assam; found in well-drained hill slopes from the Himalaya of Kashmir, eastwards to the Khasia Hills, westwards to Khandala on the Western Ghats, and southwards to the Nilgiris. The plant grows best at an altit. between 1300 and 1500 m.

Localities: W. Ghats: Khandala, *Santapau* 954! 10165! 10288! 10289! 10479! 10480! 10528! 10529! N. Kanara: Birchy, *Talbot* 2244! Belgaum Dt., *Ritchie*! Between Poondra and Amboli, *Burkill* 16966, 16994; Devimane Ghat, *Hallberg* and *McCann* 34456!

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Note.—The following list includes not only the more important works mentioned in the body of this paper, but also a few others on which this paper is partly based, even though not specifically mentioned in the preceding pages.

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See above under Burkill, I. H. & D. Prain.

Uline:

Monographie der Dioscoreaceen, in *Engl. Bot. Jahrb.,* 25 : 126-165, 1898.

Explanation of Plates

Plate I:

1. *Dioscorea oppositifolia* Linn. Santapau 2849. From Khandala.
2. *Dioscorea wallichii* Hook. f. Santapau 5377. From Khandala.

Plate II:

1. *Dioscorea belophylla* Voigt. W. A. Talbot 2244, in Kew herbarium; collected at Birchi, N. Kanara, 15-1-1890.

2. *Dioscorea hispida* Dennst. Collected by J. D. Hooker in Sikhim; Kew Herbarium. The fruits on the right-hand side belong to this species; the plant on the left-hand side is a different species.

Plate III:

1. *Dioscorea alata* Linn. Collected by J. H. Lace in Burma, (Lace 2706) on 2. Jan. 1905. Kew Herbarium.

2. *Dioscorea pentaphylla* Linn., var. *communis.* H. H. Haines 5109, Ranchi Dt. Kew Herbarium.

A YEAR ON A TIGRIS ISLAND

BY

E. P. Wiltshire, F.R.E.S.

(*With a map*, 3 *plates*, *one text figure and a graph*)

Synopsis

This paper describes the vegetation and associated animals of a small island on the River Tigris, Iraq, as affected by the progress of the season and the action of the waters throughout one year. Particular attention is paid to the Lepidoptera, which are grouped into three classes: (1) those resident on the island, (2) the temporary colonists, (3) the casual visitors. Different vegetational zones at different heights, due to the period of submergence, were observed, and the possibility of insects inhabiting each was studied. A striking feature was the coincidence of the season of maximum insect activity with the annual high floods covering all the ground but not the tree-tops; another, was the impermanence of the habitat, due to the violent erosion. Despite this, the habitat was of great natural interest, approximating more closely than the flora and fauna of the neighbouring banks to the virgin or primary river-biocoenosis of Mesopotamia. For, although certain species of plant and insect are exterminated on such islands by the annual submergence, the flora and fauna of the banks, protected by high bunds from flooding, are now subject to very great human interference. Photos illustrate the floods, and a map and a graph show the variation of temperature, humidity, water level, and insect activity on the island throughout the year and also the rate of the silting up of the smaller channel on one side of it. The river-flora and fauna of the Nile and the Jordan are compared with those of the Euphrates and Tigris, and the difference explained in geographical and historical terms. A new species of Lepidoptera, *Celama harouni.* Wilts. (Artiidae, Nolinae) is described and its characters illustrated.

Narrative

Residing in Baghdad continuously from October 1936 to November 1937 and having at my disposal a folding-canoe, I was able to visit Karradah Island at regular intervals throughout that period, and keep a diary of my natural history observations. Not only the insects collected and the animals observed were noted down, but a descriptive narrative of each visit was made, together with a note of the water-level, maximum and minimum temperature (as published in the 'Bagdad Times') and other climatic conditions of the day of the visit. Naturally the completed diary contained many tentative remarks and redundancies which a publication should omit. The diary is therefore here condensed into a graph and a month-by-month description of the reactions of insect and plant life on the island to the caprices of the river Tigris and the Iraqian climate. This part, however, is preceded by an introduction and general discussion; it is followed by a list of the lepidoptera.

INTRODUCTION

The Tigris at Baghdad is confined within high bunds or levees, but only fills up the intervening space when in spate. Inside these banks high water is twenty-two feet above low water. Islands inside the bund are subject to one or more submersions every year, when the floods come. Despite this, many islands are rich in insect life, as the following notes show.

Karradah island proper was * in 1936–37 about half a mile long and some two hundred yards across its widest point. It was closer to the eastern bund of the Tigris, being separated from the western bank by the main stream. Opposite the island on the western bank were gardens which provided a very favourable ground for insects; but the eastern bank was built over. The island was overgrown, along its whole length, with Euphrates poplar and tamarisk. The best growth of poplar (i.e. the biggest trees) was along the western side of the island, which here fell steeply into the main channel; but towards the southern end of the island the wood of big trees was some twenty or thirty yards across. The highest growth of tamarisk was to be found eastward of the highest growth of poplar. The eastern side of the island sloped gradually down to the minor channel, and on this slope the two trees were represented by scrub and shoots, those at the lowest level of all forming a green belt less than a foot high. Other trees did not occur on the island; willows in the Baghdad district were only found along irrigation-ditches and presumably required planting; and other Baghdad trees, found only on the mainland, included date-palm (*Phoenix*), nebek (*Zizyphus spina-christi*) mulberry, fig, orange, apricot and apple.

As for low plants and bushes, whereas the bunds were overgrown above a certain height with *Alhagi*, *Prosopis stephaniana*, and caper, none of these three occurred on Karradah island, whose vegetation, other than trees, consisted of various grasses, dock, burr (*Xanthium strumarium* L.) *Polygonum*, *Phragmites*, and *Glinus lotoides* L.; the *Phragmites* were however too few and impermanent to produce typical reed insects. Pig island, a much larger island a mile further downstream, escaped regular inundation, I believe, at that time; it had fewer trees and was thickly overgrown with *Lycium*, which was absent from Karrradah Island. The low plants of Karradah Island were buried annually by a thick mud deposit; the soil of the island was all alluvial, containing no single stone.

Thus, except for those species of plant or tree and animal which are apparently exterminated by inundation (one presumes the floods account for the absence from the island of such plants or trees as *Alhagi*, *Prosopis*, *Zizyphus* and *Lycium*) the island presented the wild riverain oasis flora and fauna of Mesopotamia, unimpoverished by human interference. The mainland, on the other hand, though possessing those missing species, was spoilt, from a naturalist's point of view, by cultivation.

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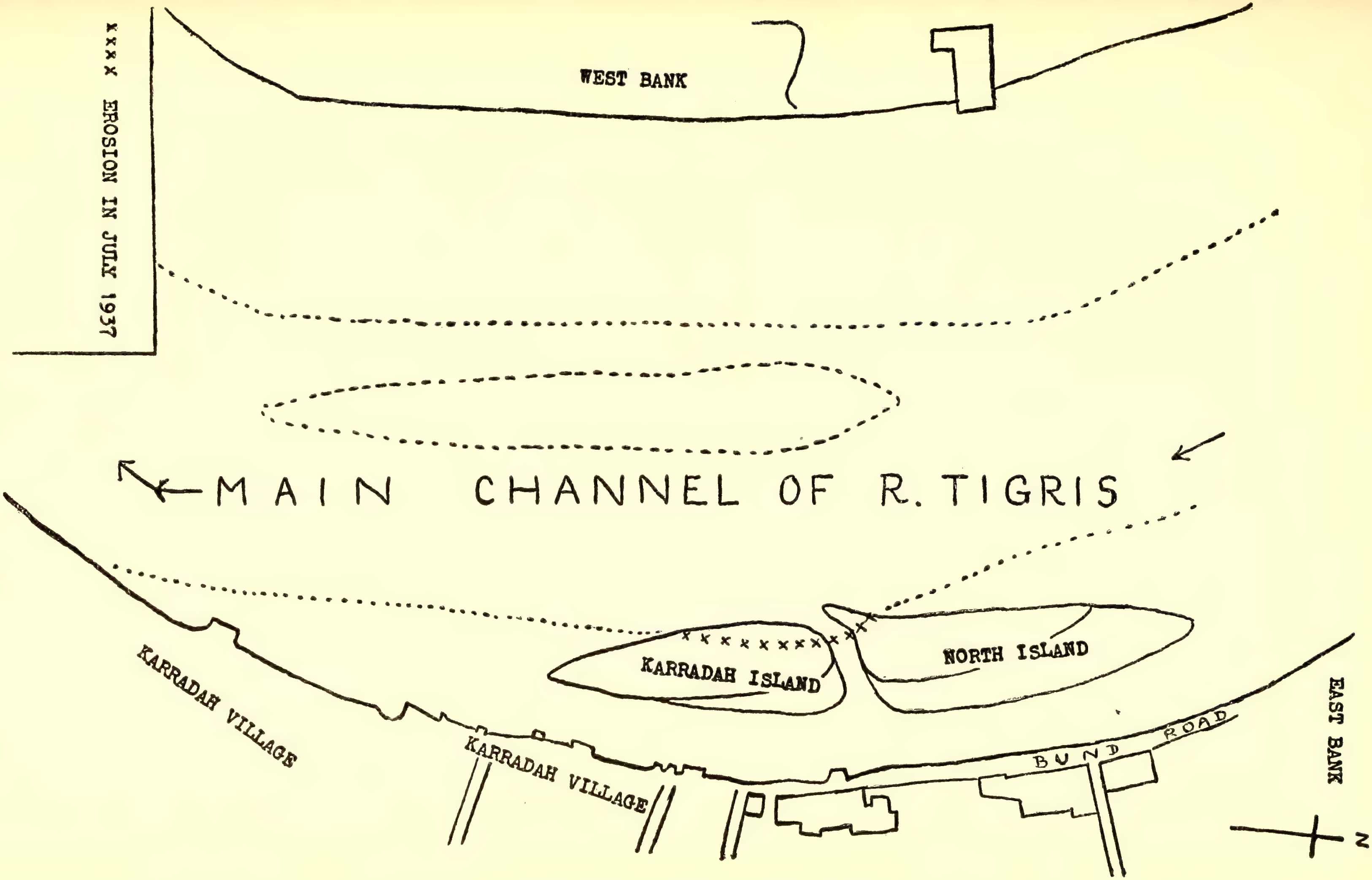
* On revisiting Baghdad in 1943 I found that the entire island with all its trees had disappeared.


x x x x EROSION IN JULY 1937
WEST BANK
MAIN CHANNEL OF R. TIGRIS
NORTH ISLAND
KARRADAH ISLAND
EAST BANK
BUND ROAD
KARRADAH VILLAGE
KARRADAH VILLAGE
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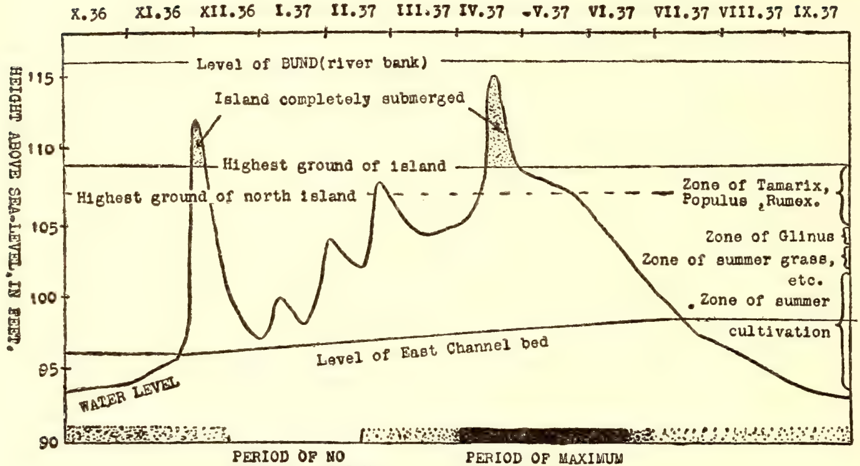
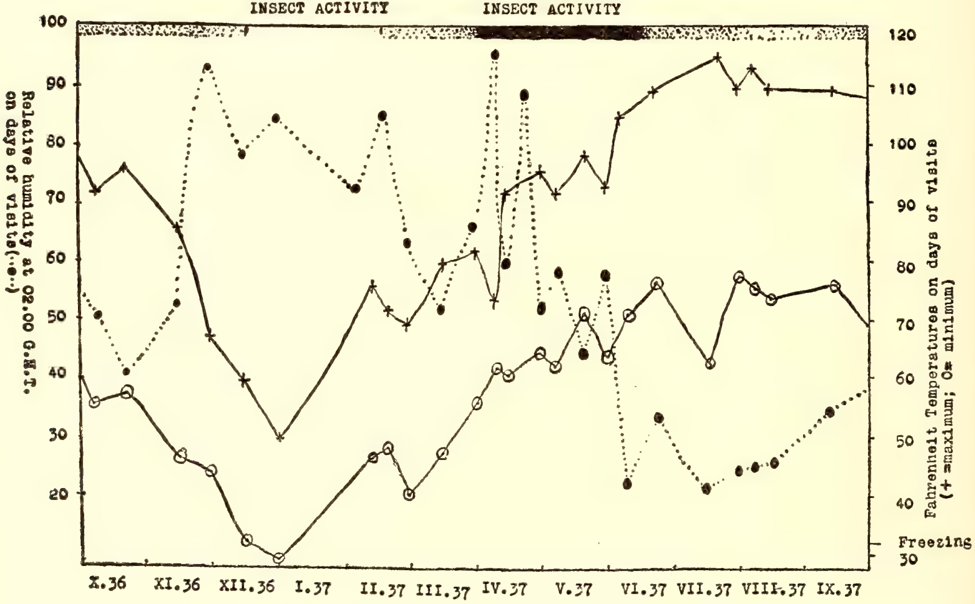
MAP OF THE TIGRIS NEAR BAGHDAD

LAND AND WATER LEVELS AND VEGETATION ZONES ON A TIGRIS ISLAND





TEMPERATURE HUMIDITY AND INSECT ACTIVITY ON A TIGRIS ISLAND

To the north of Karradah Island, a lower island stretched upstream; its highest parts were overgrown with poplar and tamarisk scrub, not high enough in 1937 to protrude from the water at its highest level; at normal levels, however, a stretch of perhaps a third of a mile broke the surface, and at low water it was united with the bank and partly cultivated. This island is referred to hereinunder as North Island.

During the year for which the island was visited and observed (October 1936—October 1937), two floods occurred high enough to cover the highest ground of Karradah Island, though not, of course, its big trees: a small sudden flood on November 30th, which lasted two or three days, and a higher flood, lasting for at least ten days, in April. The former was exceptionally early, and was due to cloudbursts in the plains and foothills of Northern Iraq; it was indeed so unexpected that irrigation constructional enterprises on the Tigris suffered heavy losses in equipment; but though unusual, this occurrence in no way detracts from the value of a study of this particular year, for the Tigris is notoriously capricious, and unusual behaviour is almost normal. The second flood, of course, was derived chiefly from the melting snows of Armenia, Kurdistan, and Persia. It might be mentioned that during the previous year, Karradah Island was submerged in April and again in May (1936). No matter when this spring flood actually comes, the island's soil is always very damp from March till June, for the melting snows and spring rains maintain the river at a high level for several months; in late summer, when the main stream flows under twelve-foot cliffs and the lesser channel is dry, the island's sub-soil water-level is considerably lower.

From about mid-December to mid-February the cold suppressed all insect life; the period of maximum activity lasted from the beginning of April to the middle of June; a period of renewed but lesser activity occurred in September and October, characterised by the frequency of other species than those most prevalent in the first period.

Special attention was paid to lepidoptera; notes were made about other orders (and, indeed, of bird and plant life too) but only a few specimens of these were collected and authoritatively named. Only the lepidoptera were collected and studied in sufficient detail to enable the drawing up of a full list, showing their status on the island. The identification of the more difficult species has taken more than ten years!

First the exact meaning of certain words used hereinunder should be explained. By the 'outer' edge or side, is meant that side of the island furthest from the main stream, the side washed by the lesser branch, i.e., in Karradah Island, the eastern side; for Karradah Island is on the left side of a river flowing southwards. The 'lower' end is therefore the southern end; the 'inner' side, is that washed by the main stream, i.e. the western; and the 'upper' end, the northern.

Every time the river covered the island, a thick deposit of silt was laid down; every year, therefore, the island grew higher. But the minor channel, on the outer side of the island, grew shallower even more quickly, since it was under silt-laden water for a longer period. The slower the stream, the more silt was dropped; in certain conditions sand was deposited: and the stream always flowed more swiftly rising than falling. During the few days for which the island was submerged, the stream was usually very rapid, and very full of silt; in places, the lack of undergrowth and wide spaces between the trunks of the big poplars, allowed the water to pass across the island very fast, while in other places the young scrub checked the flow. In either event, of course, the fastest water was in the main channel, and consequently the water crossed the island from east to west. The stream was more gentle during the long period for which it filled the eastern channel without covering the island ; in late summer and autumn, the only season when the water was really pure, the eastern channel was dry. The natural tendency of the island and its vegetation, therefore was to extend in breadth outwards, invading the bed of the lesser channel which became, each year, higher and drier. In compensation, the main channel eroded the cliff-like inner edge of the island, destroying its highest part where its flora and fauna had been longest established. A Tigris island, therefore, is a fluid thing, and I doubt if many islands can be older than a century. As the course of the main channel shifts inside the wide limits of its two bunds, new banks appear, are peopled with plants and insects, and are wiped out again. But the life survives.

The general climate of Baghdad, situated in the middle of the Great Palaearctic Desert, is marked by extremes of temperature, a certain amount of rain in winter, great dryness and heat in summer and violent winds. On Karradah Island some of these were mitigated by the prolonged moisture of the soil and the consequent density of vegetation that reduced the high evaporation typical of the true desert. The island, indeed, was used as a summer-evening resort by the inhabitants of Baghdad, on account of the coolness and freshness of its air. The annual submersion and silting-over of its whole surface, however, had so far deterred ambitious mayors from trying to urbanise it with flower-beds, paved walks, or swimming pools, and it remained wild and sylvan in 1937. A municipal keeper visited it daily, to see that its extensive timber was not plundered ; but a certain amount of lopping (chiefly of tamarisk) was even then permitted.

Similar conditions prevail on the alluvial reaches of the Euphrates and the Karun, except in three particulars: the Euphrates is more regular than the Tigris in its movements, and carries less suspended matter; the Karun is even more irregular and silt-burdened than the Tigris, being shorter ; and in the immediate neighbourhood of Basra and the Shatt-el-Arab, the river is tidal and the marshes and sea render the air more humid that in summer in Baghdad ; Baghdad is a city in a desert.

My visits and observations at once suggested the problem of whether a species of insect survived submersion, or was killed by it and recolonised the island later. I am convinced, from what I saw, that those insect species biologically dependent on the poplar and tamarisk survive the floods, which must, however, destroy many individuals; I am equally convinced that other insects, dependent on low herbage, (e.g. *Laphygma extgua*, *Loxostege nudalis*, *Hymenia fascialis-recurvalis*, etc.) are only late summer and autumn colonists from the mainland and are exterminated annually by inundation. There are however other insects, also biologically dependent on low herbage, which appeared so promptly after the subsidence of the flood-waters that I feel it very probable that they survive submersion. Among these may be mentioned *Rhodometra sacraria*, *Rivula sericealis* and *Nomophila noctuella*. Altogether, of the

COMPARATIVE VIEWS OF KARRADAH ISLAND TO ILLUSTRATE FLOODS

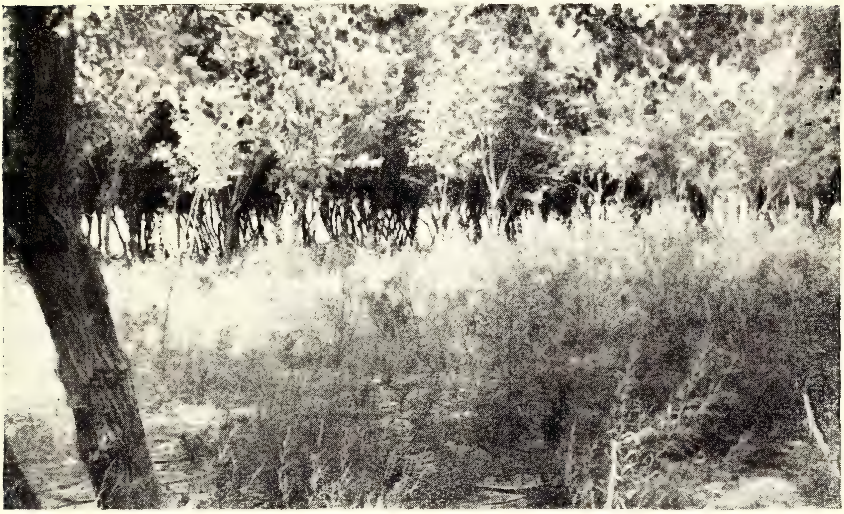


Fig. 1. The main drive, with the wood of full-grown poplars in the background, and the Tigris mainstream behind them ; looking west ; 1. xi. 1936.

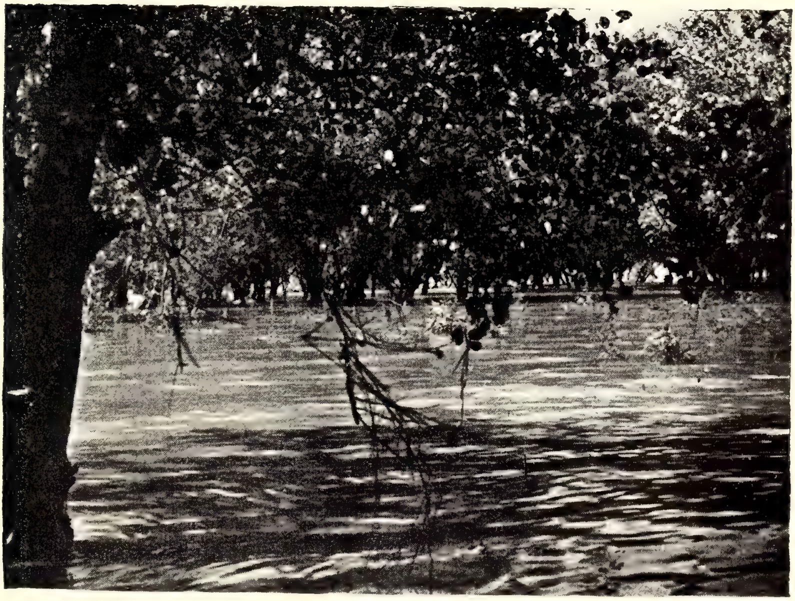


Fig. 2. Exactly the same view (except that camera was higher) ; 17. iv. 1937.

COMPARATIVE VIEWS OF KARRADAH ISLAND TO ILLUSTRATE FLOODS

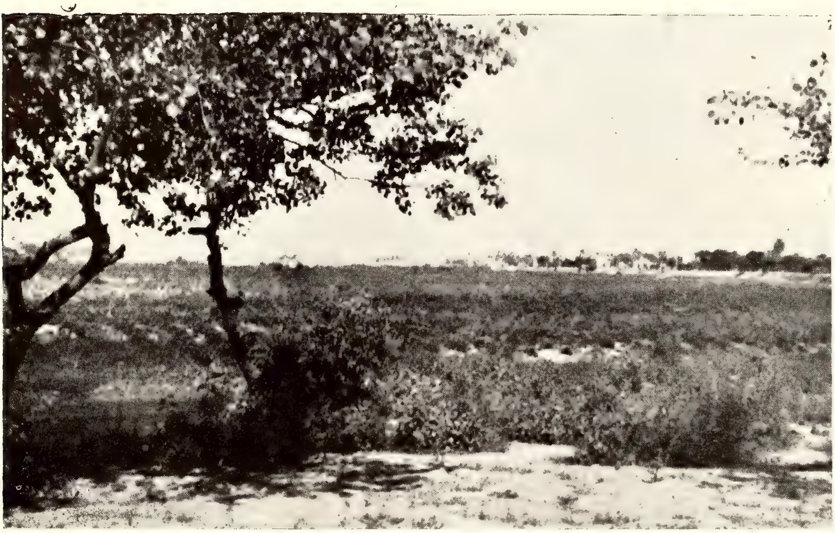
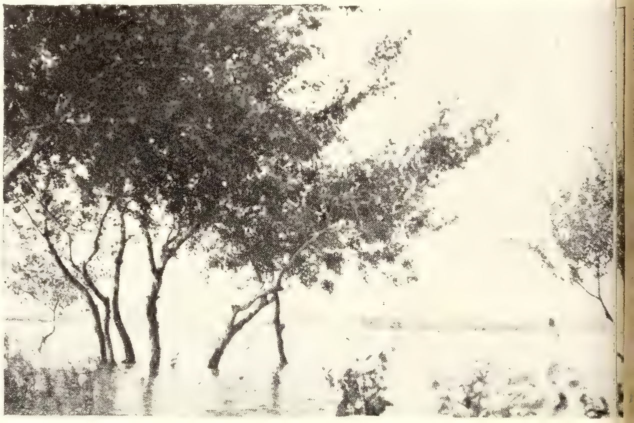


Fig. 3. North Is
viewed from the en
Karradah Island, she
the autumn cultiva
1. xi. 1936.

Fig. 4. Exactly the same view, one month later ; 1. xii. 1936.



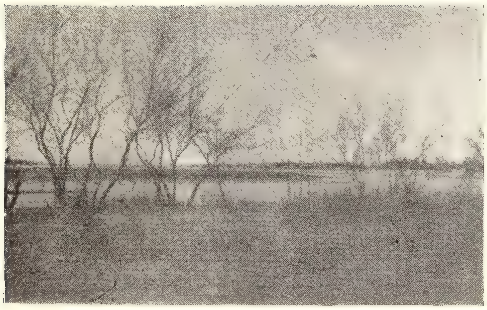


Fig. 5. The same view, 6. ii. 1937 shewing channel between North I. and Karradah I.

so-called 'Macro-lepidoptera' I think that 22 species can be regarded as permanent residents of this or similar Tigris islands, i.e. wooded islands liable to flooding. Four of these however I did not actually take on this particular island: it is from later observations elsewhere in Iraq and Persia that it has become clear that these four also belong to this ecofauna; they are listed in brackets.

As regards islands not liable to flooding annually, their flora and fauna is not distinguishable from that of the irrigated Mesopotamian plain, to which I have devoted two 'habitat articles', e.g. The Lepidoptera of a Baghdad Orchard, (*Ent. Rec.* **51**, 1939,) and Some notes on the Insects of the Shatt el Arab Oasis, (*ibid.*, **62**, 1950.)

In listing the lepidoptera at the end of this article I have grouped the above twenty-two residents separately from those which, though taken on the island, are annually exterminated by the floods, or do not even attempt to breed there. In other orders, the cockchafer (sp. ?), the cicada *Cicadatra glycyrrhizae* Klti. and perhaps the bug *Apodiphus amygdali* Germ., are also permanent residents, though in both the latter cases they would appear to be somewhat unsuitably named, for neither liquorice nor almond grows on Karradah Island.

Visitors of passage constitute a third class, of less scientific interest than either the permanent residents or the temporary colonists, but in some cases it was hard to say whether a species belonged to the second or the third, i.e., was a temporary colonist or a casual visitor. Many more of the latter would certainly have been taken on the island, especially in the late summer and autumn, if visits had been more frequent and collecting intenser. The occurrence on the island of this class, consisting of the ordinary population of the oasis of Baghdad, has no significance. In fact I took about twice as many species on the adjacent mainland as I did on the island altogether.

ORIGINS OF THIS ECOFAUNA

The temperate or Palaearctic species predominate in this river island ecofauna; the Eremic species are fairly well represented and are Palaearctic-Eremic rather than Tropical-Eremic. The Tropical category is fairly well represented, but in a distinct minority; it is better represented in the more migratory classes than in this resident class. The geographical spectrum is as follows, and the terms are explained in the footnote *:—

Palaearctic

Euro–Siberian 2, Eurooriental 3, Anatolian–Iranian 7, Pan–Eremic 3, Eastern–Eremic 2, Endemic–Eremic 1 species.

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* Euro-Siberian are Cool-temperate species ranging from the Atlantic across Siberia to the Pacific.

Eurooriental are Temperate species ranging from S. Europe to S-W. Asia, some from Britain to W. China. Anatolian-Iranian are Warm-temperate species with headquarters in the plateaux of Anatolia and Iran, and in some cases reaching the Balkans, and Afghanistan.

Eremic species are those with headquarters in the deserts and steppes north of the Equator in the Old World.

Pan-Eremic are those Eremic species distributed from West Africa to Central Asia; Eastern Eremic are those Eremic species not found west of the Nile; Endemic Eremic are those only known from Iraq at present.

Tropical

Palaeo-Tropical 2, Indo-Malayan 1, Ethiopian 0 species.

Doubtful

1 species, which will probably prove to be Anatolian-Iranian or Eremic.

The actual attribution of each of the twenty-two species to these categories is given in the list below.

The Euphrates poplar tree characterises the biotope which this article studies, and the well-known fact of its occurrence and indeed dominance along the banks of the Jordan, as well as in the Euphrates-Tigris basin, has already suggested to writers the common origin of the flora and fauna of these two river-valleys now separated by the wide and waterless expanse of the Syrian desert. The tree's world-range must also be considered; its western limit is apparently at Siwa Oasis in North-Western Egypt; its next nearest stands are five hundred miles distant, viz., in Arabia Petraea and Palestine. To the north it reaches South-East Turkey, and to the east of the Tigris it occurs quite commonly in various Persian rivers, even at 5,000–6 000 feet heights, e.g., the Zaindeh Rud at Isfahan, and the Kur at Bandamir (Fars). It is also dominant in the Tarim river-basin in the Sinkiang desert, and may even extend further eastwards in the deserts of Asia. Unfortunately information is lacking about the insect fauna of this tree at the two extremities of its range. If any species were found to attend the tree throughout its entire range that species might be fairly deduced to be of extreme antiquity and to date from the evidently geologically remote age when the tree's range was less broken up than now. The lepidoptera of Palestine however are quite well-known, and it is remarkable that of the twelve poplar-feeding species found in Baghdad, only five are definitely known from Palestine, e.g. *Catocala elocata*, *puerpera* and *lesbia*, *Acronycta aceris* and *Pandesma anysa*. The tamarisk-feeders on the other hand are the same in both countries. The probable cause of the poorer representation of the poplar-fauna in Palestine is the absence in Syria and Palestine of any river flowing from the Anatolian plateau southwards the whole length of those countries, in the way that the Euphrates and Tigris flow right through Iraq. The poplar-insects are evidently derived from the poplar-feeding fauna of Anatolia and Iran, and the relations of this fauna to the poplar-feeding fauna of Central Asia must for the present remain uncertain.

This fauna becomes progressively weaker as the rivers issuing from the Turkish and Persian mountains reach lower, drier, hotter and more southerly tracts; at Baghdad the fauna is still comparatively rich, though the absence of *Saturnia pyri* (feeding on *Populus euphratica* at Shapur in Fars !) may be noted; while at Basra and Ahwaz it is very poor.

The tamarisk-feeding fauna, which is discussed in Part II of my 'The Lepidoptera of the Kingdom of Egypt' (*Bull. Soc. Fouad I. d'Ent.* 33. (1949), is Eremic, some members being Pan-Eremic. The direction, therefore, from which such species as *Macaria aestimaria* reached our Tigris island is anybody's guess, and we can hardly venture further than to say that here they are more or less at their centre of distribution.

The different origin of the Tropical elements of the Jordan valley, on the one hand, and the Euphrates-Tigris basin on the other, is very marked and contrasts strongly with the common origin of the Temperate and Eremic species of these two basins. The Tropical components of the Jordan fauna link that river with the Nile rather than with Asia. Of course, it is true that India and Africa share many species of their Tropical fauna, and the Ethiopian and Indo-Malay categories can be to some extent grouped into a single Palaeo-Tropical fauna, of which the Ethiopian and Indian components are fairly closely related. Some of the species common to both inhabit the Tigris, Jordan and Nile valleys alike (e.g. *Pandesma anysa*, *Danais chrysippus*, *Lampides baeticus*) and shed little light on the origins. These three, it may be noted, are all migrants. But *N. siva* (not a migrant) is one of several Tropical Indian species inhabiting the Tigris valley (also South Persia); it reaches no further westwards. The tropical species of the Jordan valley on the other hand reached that depression from Africa via the rift valley at Akaba and some reach their easternmost limit there.

Owing to Iraq's more northerly situation and to the absence of rivers flowing northwards, like the Nile, out of the Tropics, there is no *Acacia* in the Tigris valley. The nearest natural stand of this tree known to me is at Bushire (S.-W. Persia). The absence of this genus of trees has deprived the river fauna of many Sudanian-Deccanian species found in the Jordan valley and Dead Sea vicinity; while the converse is the case in Egypt, which lacks an indigenous poplar-or willow-feeding fauna. Thus the Nile's fauna at Cairo is predominantly Tropical and Eremic, while the fauna of the Tigris at Baghdad is predominantly Temperate and Eremic. (Parodoxically, summer at Baghdad is hotter than at Cairo!) The direction of the flow of the principal river is decisive in determining the flora and fauna of its banks and islands, in Egypt and Iraq.

In comparing origins, we must also remind ourselves of the recent emergence from the sea of the plain of Southern Iraq. Baghdad and the island of our study were all under the salt waters of the Persian Gulf during much of the Pleistocene, and perhaps as recently as the last glaciation.

Chronological Notes

January:

The water was low most of the month (98 feet), but rose at the end to 104 feet, a level which I consider normal because it leaves exposed the tree-, or scrub-grown high ground of both islands, but covers their sandier lower parts, which are submerged too long for tamarisk and poplar to grow there and which are cultivated during the summer.

The weather was too cold for insect activity; humidity was high.

February:

At the beginning of the month, the water rose to 106 feet after some rain in Northern Iraq; then dropped again to 104; and on the 21st, rose abruptly to 108. At this level, North Island was covered, but the higher parts of Karradah Island were still exposed. A height of 109 feet is necessary to cover the ground of the latter completely.

On the upper end of North Island (a gradually shelving mud spit) sea-gulls, hoody crows, and some smaller birds constantly collected, attracted by the city's refuse, washed up there. Kites (*Milvus migrans*) were also seen on N. Island, and hoody crows (*Corvus cornix capellanus*) were common in the big trees of K. Island.

A carpet of dead leaves still covered November's silt deposit on K. Island, fresh mud was deposited early in the month on the 'glinus-shelf' at the island's upper, inner corner (this shelf is described under November and December, below), so that all except the glinus plants at the very top of the slope were buried; the mud's surface was pierced only by a few tamarisk stems, an occasional live dock, and one or two large dead burr stems. Rain fell during the month and humidity was high. At the end of the month, as the temperature rose, the poplar-buds burst and young leaves and catkins appeared.

A visit by canoe on the last day of the month revealed young leaves on tamarisk also, and, in the open spaces and clearings of K. Island, fresh grass, dock, and polygonum, and a rough-leaved, pink-flowered crucifera, whose leaves were being mauled by a coleopterous larva. *Pieris rapae* visited these flowers, large dragon-flies were on the wing, and crickets; grasshoppers and ground-spiders were seen in numbers in the clearings; in the wood of big poplars there is no undergrowth at any time of the year, but here many of the same large, quick-running spiders were seen. Small spiders were noted on the poplar trees, and three species of ant:

No. 1 was very small, quick-moving, and shelter-loving. Certain trees seemed to have been killed by it, their bark being quite dead loose from the trunk and burnt-looking. They seemed to prefer the inner surface of thin, smooth bark, but were noted on old more rugged trunks. A pupa of *Plutella maculipennis* was found among a swarm of this ant, under some loose bark; they were not molesting it, and it produced the imago on 21.iii.37.

No. 2 was rather larger, and lived deeper in the wood, often however coming to the surface through holes or cracks in the bark.

No. 3 larger and solitary; a slow mover, often surrounded by swarms of No. 1.

I also noted a *Cerura turbida clarior* Wilts. cocoon, with a slight hole at one end. On opening the cocoon it was found to contain a swarm of ant No. 1, which could only have entered through this hole, presumably made by the emerging imago some time previously. The pupa case was also full of ants, but since there was no sign of juice or fat, I assumed it had been empty when the ants arrived; what they were doing there, I failed to understand.

A small beetle was also noted, common on poplar bark.

About the same time *Celama* hibernating larvae, found the previous autumn on tamarisk, resumed feeding.

March:

The water remained at 104 or 105 ft. all the month.

Hot sunny weather, tempered by heavy dews and a fall of 33 degrees fahrenheit at night. Vegetation in the clearing grew rank.

The insects mentioned for the end of February remained very much in evidence; the shrill chirping of grasshoppers on the island could be heard clearly on the east bank at the end of the month. Pale grey weevils appeared in profusion, on low plants and tamarisk bushes.

Larvae of *P. anysa* fed up rapidly on poplar, some being mature at the end of the month; imagines of *Dicranura intermedia* and *Cerura*

COMPARATIVE VIEWS OF KARRADAH ISLAND
TO ILLUSTRATE FLOODS

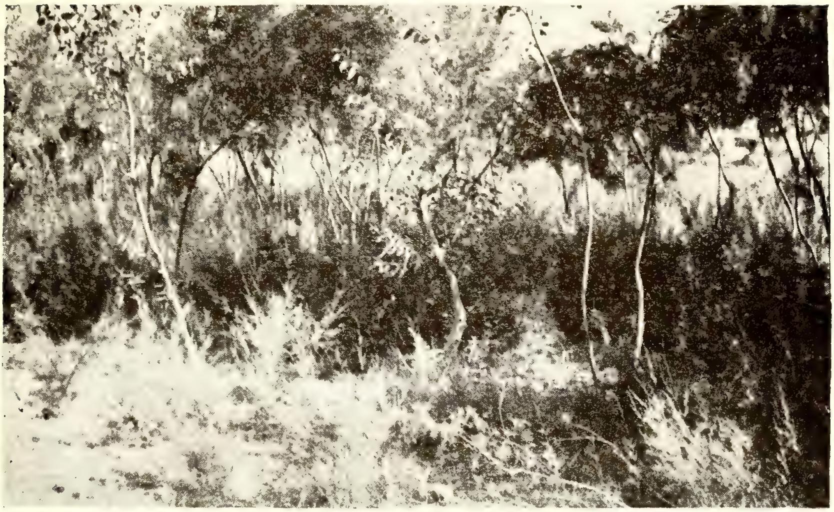


Fig. 6. Tamarisk jungle, viewed from the main drive, looking north-east from the same spot as the photo below ; 1. xi. 1937.

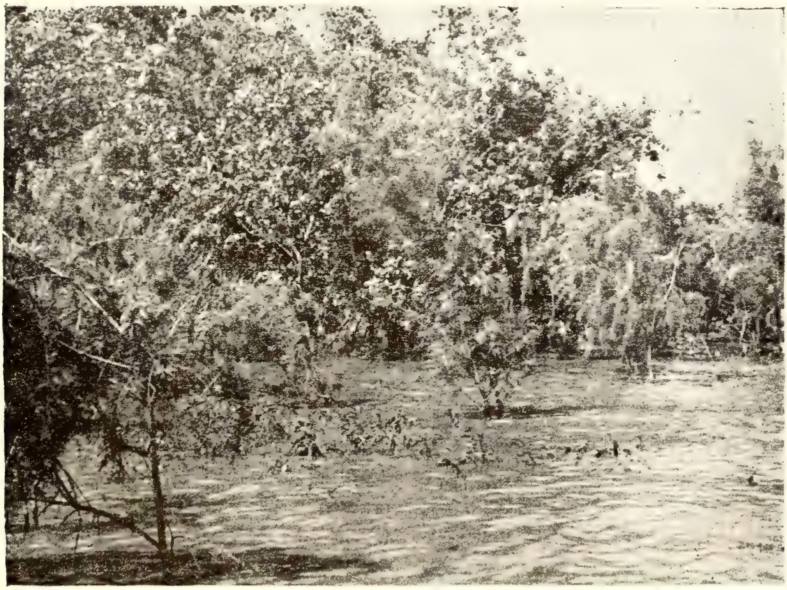


Fig. 7. A view from the same spot, looking northwards, shewing poplar wood on left, tamarisks on right and in foreground ; 17. iv. 1937.

turbida clarior were on the wing, and *Eusphecia pimplaeformis* pupated. Pupae of *Acronycta aceris johanna* and *Nadiasa siva* were found in cocoons on poplar trunks, and produced imagines in mid-April and 26th March respectively.

April :

About the 10th, the river began rapidly to rise, because of a combination of the melting snows in Kurdistan and heavy rains in N. Iraq. On the 16th, having stood at 115 feet for three days, the Tigris broke its banks north of Baghdad and flooded a wide stretch of desert east of the city.

The weather in Baghdad was on the whole fine, though some rain fell after the peak of the flood had passed. The heat was tempered by the cool breath of the swollen Tigris waters in the second half of the month, and, on many days, by a fresh north wind.

On the 17th, when a canoe-visit was paid to the inundated island and it was possible to navigate between the poplar-trunks it was noted that the water actually flowed across some parts of the island in an upstream direction ; a strong backwash in the eastern channel enabled me to return a mile upstream in 20 minutes, without paddling a single stroke, but propelled by a strong southerly wind which filled the spread beating-tray.

At the end of the month the island was not yet dry enough to land on, though the high ground appeared again above the surface about the 26th.

These floods are said to bring down snakes which climb into the branches of bushes and trees on inundated islands ; but I myself noted none. Early in the month, the tamarisks came out in white flower ; the low plants (*Polygonum*, dock, etc.), but not the burr, also flowered now. The poplars had fleshy grey-green catkins fully extended, and their thick leaves were already much disfigured by galls. On their trunks micro-lepidoptera abounded, ants were active, and a small red beetle, not noted in March, was seen. The weevil mentioned under March, above, was found in masses under loose poplar-bark, together with companies of caterpillars, large and small, of *Pandesma anysa*, which feed at night : on one strip of bark, no less than twenty larvae in the last instar, of this species were found, not to mention the less mature ones ; and probably every tree contained as many. Most of these would have pupated when the flood came, and would be unable to move higher up the trunk to escape the water, but whether or not the floods would kill the pupae is uncertain. Among such multitudes, the larvae of *Catocala optima*, whose imago was taken here later in the year, were overlooked.

Imagines of *E. pimplaeformis* were on the wing during the first half of the month ; so, still, was *Cerura turbida clarior*'s first brood, though first-brood larvae of *D. intermedia* were full-grown early in the month ; in early April, also, flew the first, brown, generation of *Earias irakana*, and many other moths. Curiously enough, no imagines were now seen of those species, dependent on low herbage, which appeared in profusion in early May (see below), soon after the floods had subsided.

A search on the mainland for the clearwing moth revealed that the poplars on the mainland were affected by a pest not found on the island, namely, a termite, whose runs are commonly seen on the trunks of *Populus euphratica* by roadsides and in gardens, extending upwards to a height of 12 feet or more; the obvious inference is that submersion is fatal to this insect.

When the island is submerged, the trees form the only refuge for those insects that are not protected by cocoons or by an underground mode of life. At its highest the water is five or six feet deep on the island's highest ground; a mature poplar's branches usually begin at ten feet above the ground. The Euphrates poplar is not pointed in form, but squat and umbrageous. When the island was submerged, many trees seemed, at a distance, to be wearing thick black necklaces, which, as one approached, proved to be clusters of large ants. The commonest animal taking refuge on the tree-trunks was the spider mentioned under March, above, the females carrying their silken balls of eggs behind them. In places where the tips of the rank vegetation in the clearings were just visible on the water's surface, these same spiders were observed hopping about on the water itself. The lady-bird *Chilocorus bipustulatus* L. was seen taking refuge on the tips of tamarisk bushes.

Two cranes (*Grus grus*) were seen in the trees.

In the middle of the month, just at the peak of the flood, the captive pupae formed by the larvae of *Grammodes rogenhoferi* and the two *Clytie* species found on the island the autumn before, started producing imagines. This unfortunate coincidence perhaps accounted for the scarcity of these species in early summer, though by autumn 1937 their larvae were again abundant.

The imagines of *Acronycta aceris johanna* were more fortunate this year, for captive pupae produced no imagines before the last few days of the month, about which time the first imagines from the current year's larvae of *P. anysa* hatched out. The first imago of the second brood of *D. intermedia* emerged in captivity on April 30th.

May :

The river remained at about 108 feet the whole month, so that K. Island was hardly a foot above the water, while N. Island was submerged all the time. The ground was soft, and if one stood for long in one place, one's feet would slowly sink in, and water would collect in the print. Such conditions were very favourable to vegetable growth, and recur regularly at about the same time every year. The heat increased, and, except for occasional rain and thunder, the air grew drier.

The white downy fluff of the poplar catkins started blowing about early in the month, and during May and June covered the ground with a cottony carpet and rested on the tamarisk trees like web or snow. The flood had not hurt the rank undergrowth of dock and *Polygonum.* This vegetation was now alive with spiders and small lepidoptera, the commonest of the latter being *Nomophila noctuella,* and *Eromene islamella*, *Rivula sericealis*, *Nymphula affinialis*, and *Rhodometra sacraria* being also numerous. The western bank of the Tigris (the only bank at this point where these species can breed) was separated by the full width of the river's turbulent main-stream. I incline to believe that the pupae of these species had survived submersion rather than that they had crossed this barrier in these numbers so soon, for I know that at least two of them are polygonum-feeders ; but certainty is impossible.

Beating tamarisks produced a few coleoptera but no lepidopterous larvae, a great contrast with later in the year. Beating poplar foliage produced small second-brood *anysa* larvae, immature larvae of *N. siva* and *E. irakana*, and many *irakana* imagines, of the second (typical, green) generation; these latter were hard to catch because of their erratic flight when disturbed. Showers of bugs, aphids, beetles and other small insects also fell into the tray from the poplar branches.

Light attracted many lepidoptera, and also swarms of sand-flies, and many lacewing flies, beetles and neuroptera. During the greater part of this month a species of flying grasshopper came to light in swarms all over Baghdad, but none came to light on the island ; one can only conclude that this particular species, like the termite, cannot live under the peculiar conditions of the island. Other kinds of grasshopper do, however, occur on it, as already mentioned ; but they did not come to light. At night the song of crickets and grasshoppers was continuous, and two kinds could be distinguished : a long-drawn-out trilling, and a shriller, interrupted rasping.

Towards the end of the month *Lycaena phloeas* appeared on the island, as well as many fresh *R. sacraria* in perfect condition, presumably just hatched from pupae in the *Polygonum,* on which plant I have found its larvae. *P. rapae* was quite common on the wing also.

Altogether, this was the month of greatest insect-activity, and, unlike the previous May, no submersion checked Nature's processes.

June :

During this month the river steadily fell to about 100 feet above sea-level, and North Island reappeared above water.

Poplar-fluff whitened the island, *Polygonum* was still green, but dock went to seed. In places the young growth of burr was a foot high, but still with no sign of flower. The 'glinus-shelf' was once more exposed, and the thick deposit thereon was pierced by young seedlings, not yet recognisable, and not like *Glinus.* The weather was hot and dry, and the sunlight uninterrupted.

During the first half of the month, insect activity was high, but decreased in the second half. Several moths, of the casual or colonist class, now made their appearance on the island ; the only resident, not previously noted, to be seen in this month for the first time was *Catocala optima* Stgr. (3. vi. 37). *P. anysa* and *E. irakana* were common early in the month ; in the second and subsequent weeks, a beautiful green cicada (*Cicadatra glycyrrhizae* Klti.) appeared, leaving its pupal exuvia on trees and low plants all over the island ; the second brood of *Cerura turbida clarior* was noted ; and a large, handsome, red-gold bug (*Apodiphus amygdali* Germ.) was noted commonly on poplar trunks. Beating tamarisk began, for the first time in the year, to be productive, young *Clytie* larvae being so obtained. Beating poplar, on the other hand, was, if anything, less productive than before.

July :

By the middle of this month the water had dropped to 98 ft., Karradah Island and North Island were united with each other and the bank, and it became possible therefore to walk onto them from the East Bund; this had not been possible at the same water-level in December and January, but the bed of the East channel had become two feet shallower during the intervening six months.

A new sandbank having formed in the bed of the main stream just west of the upper end of Karradah Island, the main current of the Tigris, swinging eastwards in a circle round this obstacle, began to make serious inroads on the lower end of North Island and on the 'glinus-shelf' of Karradah Island. All day and all night the splashes of earth-falls from the inner cliff-face of both islands could be heard. Owing to the youth of the vegetation on North Island and the 'glinus-shelf', these places offered less resistance to the erosion than did the lower inner edge of Karradah Island; but even here, cliff-falls occurred and trees were lost. Erosion along the lower, inner edge of the island was a regular, annual phenomenon; erosion, to such a marked degree, of North Island and the upper, inner corner of Karradah Island, was irregular, and had not occurred before 1937. The irregular erosion, occurring just opposite the new sandbank, was much more violent than the erosion occurring a few hundred yards downstream. The result will be seen in the following months.

Dock was dead and stiff on the island; burr not yet mature.

To light, sandflies were numerous; lacewing flies, green cicadas, and beetles also came; moths came in single specimens of a species, except for *Utetheisa pulchella* of which several came to the sheet.

August:

The water fell from 96 to 95 feet during this month.

Serious erosion continued all the month, the widest inroad being made just in the now dry bed of the narrow channel separating Karradah Island from North Island; here, some 20 yards of alluvial soil, unprotected by any vegetable growth, was lost. A sweeping bay, full of eddies, and a few fallen trees, now replaced the lower spit of North Island, the dividing channel, and the 'glinus shelf.' Northwards from this point, a wide sector of North Island disappeared, but the shrub-grown high ground of Karradah Island provided tougher opposition.

The pumps which in winter and spring drew water to irrigate the gardens or fields lying behind the houses on the eastern bund from the eastern channel, were now fed by deep ditches cut through the dry bed of this channel to the main stream of the Tigris; or, in one case, by a pipe running straight across the channel-bed and through the wood to the steep inner cliff of Karradah Island.

The sub-soil water-level fell so low, that the polygonum and dock now formed dense tangles of dead stems of a deep purple colour; the burr, on the other hand, had not yet fruited. The drives and clearings of the island became an almost impassable jungle owing to this undergrowth and the new tall growth of poplar and tamarisk shoots; comfortable walking was only possible under the big poplar trees.

The outer slopes of Karradah Island, which had been covered by the waters of the eastern channel earlier, were now fairly verdant with grass, Indian chickweed (*Glinus lotoides*), and seedlings of poplar and tamarisk. Here, numbers of *Z. karsandra* were seen flying, and *P. rapae*, *L. phloeas*, and *Utetheisa pulehella* were also noted. The gold-red bug was still common on the trees, and dragonflies, ichneumons and flying beetles were seen. But on the whole, insect life was considerably reduced, with the exception of one or two species that seemed commoner than before, notably *R. sacraria.* The cocoon-fluff of the small parasite of *Acronycta aceris johanna* was a common sight on poplar leaves.

September (1937):

The water fell from 94 to 93 during this month.

Erosion ceased, the Tigris being now at its lowest, slowest and purest, no longer directly washing the inner cliffs of the island. These cliffs were twelve feet high in places. It was still very hot; humidity rose into the thirties, but no rain fell.

Burr (*X. strumarium*) was now fruiting, its best growth being along the outer slopes of the island, between the 12-foot-high tamarisk trees and the 3-foot-high tamarisk shoots; here the burr formed a belt, 15 feet wide at its widest, in which the plants often attained a height of 10 feet.

A second brood of *Acronycta aceris johanna* appeared, and a second, more numerous but smaller, brood of *Lepidogma wiltshirei* Amsel. These species, with other moths, were attracted to light, which seemed now more effective than in August. Lacewing flies, beetles, and large diptera also came to the sheet. Beating tamarisk produced various Noctuid Quadrifid larvae, and beetles and spiders, but beating poplars was unproductive.

Grammodes rogenhoferi, a black moth with a white pattern, proved to be a day-flier, but never left the thick jungle of tamarisk or the belt of burr; in these environments, the intense sunshine variegated with shadows made it extremely hard to follow with the eye, and the vegetation even harder to follow with the net. In the evening it was still active on the wing, together with *Ophiusa algira*, from which it cannot be distinguished until caught.

I also examined the borings of subterranean insects through the silt deposit on the island, which was now cracked and could be picked up in slabs. Vertical passages ran deeper down than was possible to follow them, and in some cases passages were found that had failed to reach the surface; at the top of these, dead cockchafer imagines were found, the same species that came to light commonly in the summer.

October:

The water remained at about 93½ ft. all the month.

The records for this October and November and December were made in 1936, the year before the destructive erosion above recorded.

The surface soil of the whole island was now very dry and cracked. Low plants other than the still luxuriant burr were dead, except low down on the outer (eastern) slopes. In the bed of East channel grass was growing. On the island, many tamarisks had been lopped, some right down to the ground. Westward of, and below, the island, low sandbanks were being cultivated. The channel between Karradah Island and North Island was dry for a length of 150 yards, except for a pool of water in one place, and was even grassier than the bed of East channel. It widened as it led into the main stream, which it did obliquely, being separated from it by a long shelving spit protruding from the lower inner end of North Island. (This spit was entirely destroyed in summer 1937.) Opposite this spit, on the upper inner corner of Karradah Island, was a gradual slope, steep at the top but more gradual lower down, leading down from the poplar wood to the channel bed which was here quite thirty yards wide. This slope was overgrown with Indian chickweed (*Glinus lotoides*) and is referred to as the ' glinus-shelf'

Examination of a cliff-fall at the lower inner end of Karradah Island (a fall exposing the roots of a poplar tree) shewed that at a depth of nine feet below the surface of the ground long horizontal roots, three or four inches thick, run out from the main stem. A horizontal root was exposed for a length of quite ten feet, and was probably much longer than this in all. Such were the reinforcements to the island's foundations provided by a mature growth of *Populus euphratica.*

Beating tamarisks produced *Macaria aestimaria* larvae and several species of Noctuid-Quadrifid larvae in profusion. Caterpillars of *Laphygma exigua* were found by day under *Glinus* tufts some taking refuge from the heat under a thick slab of cracked mud. At least five species of butterfly were noted, some in abundance, and most of the species of moth mentioned for September were still active.

November:

The water remained at about 95 feet above sea-level till the 28th. About the 22nd light rains fell in Baghdad and heavier rainfall occurred in Northern Iraq. On the 28th the water rose to 102 feet, on the morning of the 29th it stood at 106 feet, and on November 30th it was 112 feet.

Similar rainfall in spring, when the Tigris is already swollen by the melting snows, would be disastrous; but in an almost empty stream-bed, the flood-peak was able to pass swiftly down to the sea without any danger of broken banks.

The first half of the month resembled October climatically, but nights gradually grew colder, the burr plants began to wither, and insects fell off. The pretty tussock-caterpillar of the *Acronycta* decorated the foliage of many a poplar, being especially conspicuous on young, low bushes; and two species of *Clytie* were common at night on low tamarisk shoots. No tamarisk on the island is old or large enough for these larvae to pupate under the bark or in the forks of the branches (as *Clytie sancta* does at Beirut) and they must therefore be obliged to spin up at the roots of the tree. Many of the poplar-feeding larvae, on the other hand, spin cocoons on the trunks of their host-tree, which gives them an advantage over tamarisk-feeders when the floods come. The larvae of the latter are most abundant in autumn, when the river is at its lowest; the poplar-feeders in early summer, when it is at its highest. Nevertheless, a pupa at the root of a tree, if not actually killed by submersion, will have a better chance of producing an imago than a pupa in the ground under *Glinus* or some other low plant, as will be explained under December, below.

December:

By the middle of the month the water had fallen again to 105 feet, and dropped to 97 at the end of the year. At 100 feet North Island was united to Karradah Island by a neck of mud, for the dividing channel was silting up rapidly.

The flood at the beginning of the month no doubt drowned many full-grown larvae on the point of pupation, especially since ovipositing females do not discriminate between high trees and lower growth. Larvae feeding on the former have only to climb upwards to escape the water, but those on the latter must be drowned. This was illustrated by what was seen on a canoe-visit that I made on December 1st, when I paddled down the centre of the island between the trees. On a young poplar-bush some three feet high growing in the main drive, clinging limply to a topmost twig, was a dead full-grown lappet-larva (*Nadiasa siva*); it hung there some 18 inches above the subsiding water-level; but straws on branches indicated that the water had been some two feet higher a day or two before.

No live larvae were seen, though various beetles were found on the tips of tamarisk scrub.

It was noted, on this occasion, that the mud deposit was higher in the tamarisk-scrub than in the clearings and paths and than under the big poplars, where no undergrowth was, for the scrub checked the speed of the water and increased precipitation. In the main drive, I found the water about nine inches deep, with a very soft bottom; bubbles were rising from the mud. I also paddled up a diagonal path or clearing between tamarisk-scrub from the inner side of the island for some way, but was unable to penetrate into the main drive because the water in this clearing was shallower; in fact, in places on either side of the canoe the mud under the tamarisk shoots was already above the water-level; air escaping from under this exposed mud made a loud sizzling sound as it burst the water-film or passed through the shallow puddles in the ridges of the fresh silt.

About the middle of the month, it became too cold for insect activity, the minimum daily temperature being at freezing point for several days. A few hoody crows (*Corvus cornix capellanus*) came to forage on the island, two species of kingfisher were seen, and smaller birds were observed on the shelving upper end of North Island. Flocks of migrating birds passed over Baghdad, flying southwards. Smaller companies of waterfowl occasionally settled in the shelter of the dividing channel.

About two weeks after the re-emergence of the high ground of Karradah Island from the flood-waters, observations of the mud-deposit were made. It was still soft enough to give about an inch when trodden on, was thickly littered with dead poplar leaves, and already cracking. As yet, these cracks were only ½″ wide at the most. They radiated from, or were tangent to, tree-trunks, and a space of at least ½″ was left round every trunk or thick stem, where the mud, solidifying, had drawn away. This was even so where quite young tamarisk shoots, growing from old roots, pierced the silt, but not where grasses or low plants protruded. If not entirely covered with mud, the protruding blade of grass or twig of the low plant, was tightly gripped in the deposit, and no interval or crack was there to permit the upward passage of any insect resting at the roots that might have survived the submersion. The fresh, sloping mud deposit, on the 'glinus-shelf' was cracking, indeed, at its drier higher levels, but the vegetation played no part here in determining the course of these cracks. If a crack touched a glinus stem, it was quite by chance, nor was the stem, even in this case, free from the mud on either side; in the majority of cases the glinus was completely smothered by the mud. I concluded therefore that these conditions would prevent any *exigua* pupae surviving the winter here, or elsewhere on the island, for this plant only grew at one level on the island's slopes. The 'shelf' would, of course, be under water longer than the higher parts of the island; in fact the water-graph shews that the levels of the island at which this plant grows are submerged for five whole months. This consideration enabled me to distinguish between two classes of low herbage, and of moths feeding thereon: firstly, those, like *R. sacraria* and *N. noctuella* dependent on the *Polygonum*, etc., of the clearings on the higher part of the island; and, secondly, those insects dependent on the *Glinus* and crops of cucumber and beans, etc., at a lower level. The relatively short submersion of the first class, and the relatively light silt-deposit, would perhaps permit a certain proportion to survive the floods; but the longer submersion and consequently heavier silt-deposit affecting such species as *Lampides baeticus* and *Laphygma exigua* would certainly never permit them to be more than summer colonists of the island.

ANNOTATED LIST OF LEPIDOPTERA OF KARRADAH ISLAND

The species taken during the year on the island are here grouped into three classes :—

1. Permanent residents (22).
2. Temporary colonists (8).
3. Casual visitors (17).

The numbers in brackets above represent the number of so-called Macro-Lepidoptera in each class, totalling 47 species. Owing to my comparative ignorance of the biology of many of the Micro-Lepidoptera and Pyralididae, these families are listed at the end all together (20 species); their status on the island is given where possible. I am indebted to Dr. H. G. Amsel for the identification of these latter families. For the identification of the larger moths I must acknowledge the assistance given by Mr. W. H. T. Tams, Monsieur Charles Boursin, and Herren Daniel and Warnecke.

The division into Macro- and Micro-Lepidoptera is not in accord with latest taxonomic thought, and is only followed here for convenience.

I. PERMANENT RESIDENTS

NOTODONTIDAE

1. Dicranura intermedia Teich.

Bi-voltine, both broods being vernal, the first flying in mid-March, the second in early May. Foodplant :—*Populus*. (On the mainland also on willow, *Salix*.) Early stages were described by me in *Mitt. Muench. Ent. Ges.* 1939, Heft 1 with a photograph. An Anatolian-Iranian species, ranging from East Turkey to North-West India, inhabiting oases; it reaches the mouth of the Tigris. It is a close relative of the European species *vinula* L. which reaches West Turkey. For the genitalia of both, see my article : Middle East Lepidoptera–V. (*Proc. R. Ent. Soc. Lond.* (B) 15. Parts 9–10, 1946).

2. **Cerura turbida** Brandt **clarior** Wilts.

Bi-voltine, both broods being vernal, the first flying in March and April, the second in May and June. Foodplant :—*Populus euphratica*. The early stages were described by me with photographs and the paler Baghdad race was named and described in 'Early stages of Oriental-Palaearctic Lepidoptera, V' [*Journ. Bombay Nat. Hist. Soc.*, xliii, (4) p. 624, April 1943]. An Anatolian-Iranian species of limited range, only known from Iraq and South-west Persia ; in South-east Turkey, in Syria, in North-west and North-central Persia, closely related but distinct species occur in oases, but not on the same species of poplar.

3. **Pygaera pigra ferruginea** Staudinger.

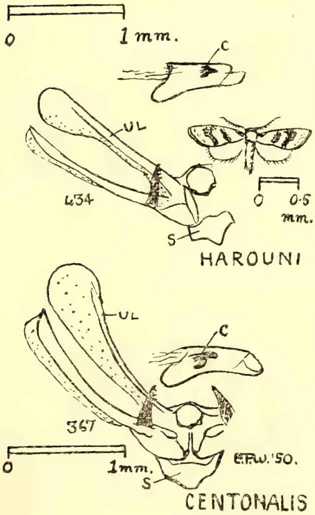
Multivoltine or bi-voltine ; its exact phenology at Baghdad has not been worked out. I took a female by beating poplar on May 5th, and a male on the mainland on 20th April. Foodplant :—*Populus* (and on mainland *Salix*). A well-known Euro-Siberian species. It is not known on the Tigris south of Baghdad, but occurs at 7,000 ft. in South-west Persia much further south. An oasis species.

ARCTIIDAE, NOLINAE

4. **Celama harouni** sp. n.

This new species is closer to *centonalis* Hubn. than the following, *turanica* Stgr. It differs from the latter principally in having antennae as in *centonalis*, and not with fascicles of cilia as in *turanica*. From both the straight course of the ante-median fascia on the forewing separate it. Its browner coloration also distinguishes it.

Male antenna, ciliate.



(For explanation of text-figure see end of article)

Fore-wing, light brown marked with dark brown as follows : a basal patch, not reaching the hind-margin ; near the costa it is composed of raised scales and its distal edge is parallel with the ante-median line and hind-margin ; the ante-median line, starting at the sub-costal from a patch of raised scales ; its distal edge is almost black, and sharply defined ; and thirdly, the post-median fascia, with an equally dark and sharply-defined distal edge, but dentate as in *centonalis* ; on the costa, just proximal to this line, is a patch of dark brown raised scales. Except for these markings, the forewing is pale, especially in the median and sub-marginal areas. Sub-marginal shade, obsolete, irregular. Termen, brown. Fringes, concolorous, darker distally.

Hind-wing, whitish, semi-transparent, with a weakly defined fuscous termen.

The male genitalia (see text-figure) are very like those of *centonalis*, but differ in the membranous part of the upper lobe of the valve ; this part is narrower in the centre of the lobe. The saccus is more pointed; and the aedeagus cornutus is also acuter than in *centonalis*, in Cyprian examples of which the cornutus is bluntly rounded.

Holotype : ♂, (Prep. 434), 1. xi. 43, Basra, S. Iraq (in coll. m.)

Bi-voltine, the broods being vernal and autumnal.

Foodplant :—probably tamarisk, perhaps also poplar. This new species, hitherto undiagnosed, and perhaps existing in many collections under the name *squalida* Stgr., probably also occurs in Syria and elsewhere in the Middle East. Its geographical classification is at present doubtful. I took it on Karradah Island on April 3rd and again on November 16th. An oasis species.

5. **Celama turanica** Stgr.

Quite common to light among poplars in June, but from its captures elsewhere it evidently has more than one brood. I have taken it at Basra on 19. iv and 9. ix. 43. I consider *henrioti* Warnecke and *parvula* Chret. conspecific with *turanica* and therefore class this species as Pan-Eremic. Foodplant :—probably tamarisk, possibly also poplar. An oasis species.

LASIOCAMPIDAE

6. **Nadiasa** (= **Taragama**) **siva** Lef.

Has about two broods annually, not very well defined, for some larvae hibernate, others do so in the pupal stage. Foodplants :—*Populus* and *Tamarix*; (also, on the mainland, *Zizyphus*, *Prosopis*, apple, pomegranate, etc.) An Indian species, firmly established in Southern Iraq, where it inhabits oases.

LYMANTRIIDAE

(7. **Ocneria signatoria poenitens** Stgr.

I did not take this on the island, and perhaps it cannot survive floods, but on the whole I think it is a permanent resident; in any case it belongs to the riverain ecofauna. Bi-voltine, flying vernally and autumnally, April and October; larvae of the second brood pupate in December. I described and illustrated the early stages in *Mitt. Muench. Ent. Ges.* xxix. Heft 1. 1939. An Anatolian-Iranian species, inhabiting Palestine. A close relative inhabits North-west Africa. Foodplant :—tamarisk).

AEGERIIDAE

8. **Eusphecia pimplaeformis** Ob.

Univoltine, vernal, flying in April. Foodplant, *Populus euphratica*, boring inside the trunk. (On the mainland at Baghdad it was also found only on this tree, but in Persia I have also noted it on *Salix*.) For the early stages see my 'The Butterflies and Moths of Iraq' (Directorate-General of Agriculture, Baghdad, October 1944), and for the morphology see Le Cerf 'Aegeriidae nouvelles ou peu connues d'Asie anterieure' (*Zeit. des Oest. Ent.-Ver.* 22, 1937.) An Anatolian–Iranian species which does not seem to occur on the Tigris much further South of Baghdad, but occurs in oases at 5,000 ft. in Fars (Sout-west Persia). It has not been taken further west than Bithynia.

AGROTIDAE (=PHALAENIDAE)

9. **Acronycta aceris** L. subsp. **johanna** Schaw.

Bi-voltine, the broods flying vernally and autumnally, in April-May, and September-October. Foodplant ; in the Middle East *Populus* is the only foodplant observed so far, and it is an oasis-moth; the typical race in Europe however feeds on various other quite unrelated trees. An Euroriental species, known from Palestine and Persia and westwards to Britain.

10. **Earias irakana** Wilts.

Probably bi-voltine, both broods being vernal, the first flying in April, the second in May-June-July. The species was described by me in *The Entom.* LXIX (October 1936) and the two forms *vernalis* and *intermedia* in ' The Butterflies and Moths of Iraq '. The spring form, hatching before the leaves are out, is procryptically coloured golden-brown to agree with the poplar bud-sheaths, whereas the summer brood is green and thus harmonises with the leaves. Foodplant: *Populus euphratica*; elsewhere perhaps also on *Salix*. This endemic species has not yet been taken outside Iraq, where it is an oasis moth.

11. **Catocala optima** Stgr.

Univoltine, flying in June. Foodplant (presumed):—*Populus euphratica*. Identification was assured by comparing with the type. A species inhabiting oases, to be classified as Anatolian-Iranian or Eastern Eremic. Before my capture of this moth on Karradah Island on the Tigris, it had previously only been known from Tedjen Oasis, Transcaspia, and Ili, Turkestan. I have seen no record of its later recapture.

(12. **Catocala elocata** Esp.

?Univoltine. Flies in Baghdad in June, but was not actually taken on the island. I have taken it at Ahwaz in October, which is perhaps the normal month of flight in the Middle East. Foodplant:—*Populus* and *Salix*. Rothschild refers the Mesopotamian form to *locata* Stgr., Brandt the Persian to *deducta* Ev. It is an oasis moth in the Middle East. Euroriental.)

(13. **Catocala puerpera** Giorn.

Phenology and foodplant, same as No. 12 *eleocata*; like it, was not actually taken on the island. A Euroriental moth, found in oases in the Middle East.)

(14. **Catocala lesbia** Christ.

Phenology at least bivoltine, perhaps multivoltine. Was not taken on the island. The early stages were described and illustrated by me in *Journ. Bombay Nat. Hist. Soc.*, XLIII, (4), p. 628. Unfortunately the foodplant was omitted there. Foodplants:—*Populus* and *Salix*. I have found it on *P. euphratica* on the banks of the Shapur River, Fars, South-west Persia. Ranges from Sinai and Palestine to South-east Persia, and is an oasis moth throughout this region.)

15. **Grammodes rogenhoferi** Bohatsch

Multivoltine. Foodplant : tamarisk. The first brood emerges in April, and must suffer heavy casualties from the floods. Larvae found feeding together with numerous *Clytie syriaca* and other *Clytie* species in autumn at night. An Anatolian-Iranian species, ranging from Armenia, Syria and Palestine to Sind. It probably has other foodplants.

16. **Clytie syriaca** Bugn.

Multivoltine. Foodplant :—Tamarisk only. The early stages were described and illustrated by me in *Mitt. Muench. Ent. Ges.* XXIX. Heft 1. 1939. The first brood hatches in April and must suffer from floods. An Anatolian-Iranian or Eastern Eremic species ranging from Syria to Persia.

17. **Clytie terrulenta** Chr.

Multivoltine. Foodplant :—Tamarisk only. The early stages were described by me in the same article referred to under No. 16, *syriaca.* The first brood hatches in April, and must suffer heavily from floods. An Anatolian-Iranian or Eastern Eremic species, known from Palestine, South-east Turkey, and Transcaucasia, as well as the Euphrates basin. (N.B. Two other *Clytie* species, with a similar foodplant, are known from the rivers of South-west Persia but not actually from the Tigris, on which however they may one day be found ; they are *sublunaris* Stgr. and *distincta* Bang-Haas subsp. *iranica* Brandt ; both are Central-Asian-Iranian rather than Anatolian-Iranian. Another closely-related tamarisk-feeder almost certainly occurs on the Tigris further south, but apparently does not penetrate northwards as far as Baghdad ; this species is the Saharan-Sindian Eremic moth *Hypoglaucitis benenotata* Warren, of which I described the early stages, with photographs, in *Ent. Rec.* 56, 1944. The larva is usually found on *Tamarix ariculata* which is not a river-tree, but planted in oases in Southern Iraq.)

18. **Pandesma anysa** Guen.

Multivoltine. Foodplant :—*Populus cuphratica.* Elsewhere it has been reported on other quite unrelated trees. It has been suggested by some authors, who found it in masses under loose bark, that it eats the wood and bark. My own experience however shows that it hides under the bark by day and eats the leaves by night. I have reared it from the egg on leaves of *P. euphratica.* The young larvae of the first brood hatch in late February. It is extremely numerous on the island in June, in which month mass emigration relieves the excess of population. It is a Tropical species of the Old World, reaching North Persia and Syria, perhaps only as immigrants. At Baghdad it certainly survives the winter and flies all through the summer in successive broods. It has been taken in the desert in numbers, but perhaps is only a migrant there.

19. **Rivula sericealis** Scop.

Multivoltine. Foodplant :—grasses. Euro-Siberian,

GEOMETRIDAE

20. **Rhodometra sacraria** L.

Foodplant:—*Polygonum.* Multivoltine. Its prompt appearance after the subsidence of the floods on its foodplant which survived inundation suggests it is also able to survive. Its migratory tendencies are however well known. Tropical.

21. **Eupithecia ultimaria.** Boisd.

Multivoltine. Taken on the wing in April, May and June; larvae seen in September and October. Foodplant:—Only tamarisk. Pan-Eremic. An oasis moth.

22. **Macaria aestimaria** Hubn.

Multivoltine, flying from February to November. Foodplant:—Only tamarisk. The early stages were described and illustrated by me in *Mitt. Muench. Ent. Ges.* 1939, Heft 1. Pan-Eremic. An oasis moth, also found on Mediterranean shores. For geographical remarks on this and other tamarisk feeders, see the final chapter, Part II of my 'Lepidoptera of the Kingdom of Egypt' (*Bull. Soc. Fouad I. d' Ent.* 33, 1949).

II. Temporary Colonists

The following colonise parts of the island after the floods subside and produce at least one generation on it before being again exterminated when the water rises again. They are permanent residents or migrants of the mainland, where they occur on ambiguous ground for the biotope is an oasis harbouring both oasis and desert species.

PIERIDAE

1. **Pieris rapae** L.

Multivoltine. Foodplant:—Cruciferae and Resedaceae. Was not actually observed in the larval stage on the island. But a possible foodplant exists (see above, under February). A migratory Holarctic pest, originally Palaearctic. It reaches the extreme south of Iraq.

LYCAENIDAE

2. **Lycaena phloeas** L.

Multivoltine. Probably not a permanent resident like *R. sacraria* (I, 20 above); it appeared soon after the subsidence of the floods, and its foodplant survived them. Foodplant:—*Rumex.* The foodplant dries up later in the summer, whereas on the mainland, along irrigation channels it persists green. Euro-Siberian; an oasis insect in the Baghdad vicinity, but it does not occur much further south in the Tigris basin.

3. **Lampides baeticus** L.

Multivoltine. Foodplant:—*Faba* (cultivated bean). As soon as this is planted on North Island and elsewhere in the river bed close to Karradah Island, it breeds; but these crops are covered every winter with water and replanted about midsummer. Tropical, migratory, common in Iraq oases, except in midwinter, which however it survives. It occurs throughout the plain of Iraq.

4. **Zizeeria knysna karsandra** Moore.

Multivoltine. Foodplant:—probably *Glinus lotoides*; anyhow, it is common in the *Glinus* and grass belt, i.e., at a very low level, on the island in August and September. Tropical, common in Iraqian oases, throughout the plain.

SPHINGIDAE

5. **Celerio lineata livornica** Esp.

A half-grown larva was found on dock (*Rumex*) on 3rd April. Together with any brothers there, it must have been drowned in the flood which came soon after. A migratory species, with a variety of possible foodplants, only one of which was seen on the island. Holo-Tropical and Sub-Tropical. Commoner in deserts than oases, especially in spring.

6. **Utetheisa pulchella** L.

(I am indebted to Dr. K. Jordan for examining the genitalia, a precaution necessary in this group of similar species). Is common on the *Glinus* and grass belt in July–August; I think its foodplant must occur there (heliotrope), though I did not note this down. A Tropical migrant, inhabiting deserts and the drier parts of oases throughout Iraq, and varying seasonally there in numbers to a great extent. Multivoltine.

7. **Laphygma exigua** Hubn.

Multivoltine. A Tropical migrant. Foodplant:—*Glinus lotoides*, and perhaps other low herbs. The pupal period is ten days only, and the *Glinus* shelf was covered for at least four months. In Iraq this species seems to migrate into the milder desert regions of the south of the country for its winter generations, returning to the oases (and also migrating into distant mountains) in the spring.

8. **Phytometra chalcites** Esp.

Apparently bi-voltine in Iraq, though a midsummer brood has been observed in Mediterranean districts. The two broods fly in Baghdad in February–March and November. On the mainland it is common feeding on garden herbs. On the island it was found feeding on burr (*Xanthium*) on 1st November. The moth was not actually taken there, but the larva was reared successfully. A Mediterranean and (assuming that *eriosoma* is a synonym), Tropical Indian species.

III. CASUAL VISITORS

These are listed here without comment; they belong to the cultivated oasis or desert fauna of Iraq, and readers may refer to my articles on that country for their phenology, range, etc. These details would not be relevant to the present study; it is only by chance that they, and not others, were taken on the island. Nevertheless, it is not impossible that one or two of them may be temporary colonists or even residents, unbeknown to me. For instance, the root-feeders *Agrotis ypsilon* and *spinifera* may quite well survive floods underground; I have, however, never observed their early stages in the Middle East; *Leucania loreyi* also might well be a temporary colonist, being a migratory species with rapid successive broods and feeding on grass: *Ophiusa algira* and *albivitta* have only been observed on *Rubus*, pomegranate and *Ricinus*, none of which grew on the island, but the capture of one of these moths flying together with *Grammodes rogenhoferi* in the belt of burr may indicate that it has a foodplant on the island like *rogenhoferi*; I suggest that it may feed on the burr (*Xanthium*) or tamarisk; on the latter its larva would easily have escaped notice among the many *Clytie* larvae, which I saw.

Casual visitors:—*Papilio machaon centralis* Stgr., *Euchloe belemia* Esp., *Glycestha aurota* F. (= *mesentina*), *Danais chrysippus* L., *Tarucus* sp. in *theophrastus* group, *Theretra alecto cretica* Boisd., *Agrotis ypsilon* Rott., *Agrotis spinifera* Hubn., *Agrotis lasserrei* Ob., *Leucania loreyi* Dup., *Prodenia litura* F., *Eublemma parva* Hubn., *Earias insulana* Boisd., *Ophiusa algira* L. or *albivitta* Moore in this connection see my 'Lepidoptera of the Kingdom of Egypt', *loc. cit. super.*, Part I, (1948) and Part II (p. 391) (1949), *Pericyma albidentaria* Freyer, *Rhynchodontodes revolutalis* Z. and *Sterrha ochroleucaria* H.S.

IV. PYRALIDIDAE AND MICRO-LEPIDOPTERA

PYRALIDIDAE

(1) **Eromene islamella** Amsel 1949. Multivoltine. (2) **Heterographis concavella** Amsel 1949. (? bivoltine). (3) **Trissonca oblitella** Z. in vi. (4) **Phycita diaphana** Stgr. bred from larvae on poplar leaves, but on mainland also feeds on castor (*Ricinus*) and *Crozophora verbascifolia*; bi-voltine, larvae full-grown in v. hatching in xi. (5) **Tephris stenopterella** Amsel 1949. Bi-voltine; feeds on *Tamarix*; also inhabits Jordan valley, Palestine. (6) **Salebria dionysa** Z. flies in v, vi, and viii. (7) **Nymphula affinialis** Guen. multivoltine. (8) **Nomophila noctuella** Schiff. A multivoltine migrant. (9) **Bostra marginalis** Roths. Flies in iv. (10) **Lepidogma wiltshirei** Amsel 1949. Bi-voltine, flying in v. and ix; probable foodplant:—*Tamarix*. (11) **Loxostege nudalis** Hamps. Taken on 28. ix, but on mainland also in iv, v. (12) **Anthophilopsis baphialis** Led. Taken on 14. vii, but on mainland also in iv. (13) **Aeschremon disparalis**, H-S. Taken on 3 iv. but on mainland also in iii. and x; associated on the bunds with *Capparis*, but it is not verified whether this is the foodplant. (14) **Hymenia fascialis** Cr. (= **recurvalis**). Flies, often by day, on the island in x and xi.

PTEROPHORIDAE

(15) **Agdistis bagdadiensis** Amsel 1949. Flies in v; presumed foodplant, *Tamarix*.

TORTRICIDAE

(16) **Bactra lanceolana** Hubn. Taken on 19. v, but on mainland also in x. (17) **Bactra venosana** Z. Taken on 3. vi, but also flies in

the desert of Iraq in x. (18) **Semasia bagdadiana** Amsel 1949. Flies in iv, vi, vii; presumed foodplant *Populus*; it is remarkable that the poplar-feeding *Semasia euphraticana* Amsel was taken by me at Basra, South Iraq, but not seen on this island at Baghdad. There can be no confusion between these two species. *S. euphraticana* was described from the Jordan valley, Palestine.

GELECHIIDAE

(19) **Gelechia plutelliformis** Stgr. Multivoltine, feeding on *Tamarix*,

HYPONOMEUTIDAE

(20) **Plutella maculipennis** Curtis. Though best known as a *Crucifera*-feeder, and migrant (it inhabits the deserts also), this little moth is closely associated with *Populus* on the island; it pupates in the bark of this tree, and sits on the trunk when hatched. However, the larvae were not actually observed eating its foliage. Common in iii and iv.

EXPLANATION OF TEXT-FIGURE

Characters distinguishing *Celama harouni* spec. nov. (434) from *Celama centonalis* Hubn. (367). The male genitalia of both are shown, ventral open view, omitting tegumen, uncus and right valve. (C = cornutus of aedeagus; UL = upper lobe of valve; S = saccus.)

[Editors' Note: The plant so often mentioned in these pages under the name of *Glinus lotoides* should be called *Mollugo lotoides* **O. Ktze.** In some of our Indian floras the same plant goes under the name of *Mollugo hirta* **Thunb.**]

A NEW RACE OF THE GROUND-THRUSH *TURDUS CITRINUS* (AVES: TURDIDAE)

BY

BISWAMOY BISWAS[1]

The Indian populations of the Orange-headed Ground-thrush, *Turdus* (*Geokichla*) *citrinus,* have so far been divided into two subspecies: (1) the orange-throated and larger *citrinus* (breeding in the sub-Himalayas), and (2) the white-throated and smaller *cyanotus* (breeding in southwestern India), with some six or more races in the Andaman and Nicobar Islands, and Malayasia. An examination of the breeding birds from different parts of India, however, shows that the populations from the Central Provinces (Madhya Pradesh) and Orissa do not fit in either race and, therefore, I propose to distinguish them as

Turdus citrinus amadoni new subspecies.

Compared with *cyanotus,* this new race has very little or no olive wash on the crown, has the anterior ear coverts and the blue-gray of the upper parts paler, and is larger in size. From *citrinus* it differs in having the throat white. In some respects *amadoni* looks intermediate between *citrinus* and *cyanotus.*

TYPE.—Amer. Mus. Nat. Hist. No. 576384; adult male; Chanda, Chanda district, Central Provinces; April 10, 1867; H. J. Elwes.

MEASUREMENTS OF THE TYPE.—Wing, 115; tail, 80; bill from skull, 23 mm.

RANGE.—Central Provinces (Madhya Pradesh), Orissa, and northeastern Madras Province.

REMARKS.—Tickell's *Turdus lividus* from Borabhum (*J. Asiat. Soc. Bengal,* **2**: 577, 1833) does not seem to refer to this new race. In the description of *T. lividus,* the most prominent character—white throat—is not mentioned at all. Tickell's list of his Borabhum collection is conspicuous with the mention of many winter visitors, and it seems that *lividus* refers to *citrinus* which is certainly a winter visitor in the Borabhum area.

It is with great pleasure that I name this new subspecies for Dr. Dean Amadon, Ornithologist in the American Museum of Natural History.

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[1] Now at the Zoological Survey of India, Indian Museum, Calcutta.

The more important distinguishing characters of the three Indian races of *Turdus citrinus* may be summarized as follows:—

	citrinus	*amadoni*	*cyanotus*
Colour of the crown.	Deep orange-chestnut.	Deep orange-chestnut, sometimes with a faint olive tinge.	Orange-chestnut, strongly suffused with olive.
Colour of the throat.	Orange-chestnut ...	White ...	White ...
Colour of the anterior ear coverts.	Orange-chestnut ...	Dark snuff brown to blackish brown.	Dark blackish-brown.
Colour of the back	Dark blue-gray ...	Dark blue-gray ...	Still darker blue-gray.
Measurements ...	10 ♂: Wing, 116–121 (118·9)[1]; tail, 75–83 (79·8); bill,[2] 23–25 (23·9)	6 ♂: Wing, 110–116 (113·3); tail, 75–83 (78·8); bill, 23–24 (23·4).	6 ♂: Wing, 106–112 (109·1); tail, 72–73, 79 (73·7); bill, 23–25 (23·7),
	5 ♀: Wing, 117–123 (119·6); tail, 76–81 (78·6); bill, 23–25 (24).	3 ♀; Wing, 113–114 (113·3); tail, 76–77 (76·3); Bill, 23–24 (23·5).	9 ♀: Wing, 102–111 (106·4); tail, 68–77 (72·5); bill, 23–24·5 (23·6).

[1] Average measurments are given in parentheses

[2] The bill is measured from the skull.

My thanks are due to the authorities of the American Museum of Natural History for allowing me to describe specimens from their collection, and to Dr. Walter Koelz for giving me permission to study his material.

COWRIES

(MOLLUSCA, GASTROPODA: FAMILY CYPRAEIDAE)

BY

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(*With two plates*)

INTRODUCTION

While a Research Scholar in the Zoological Survey of India I read a paper entitled 'A talk about Cowries' at a meeting of the Indian Association of Systematic Zoologists held at Kaiser Castle, Banaras Cantt., on 21-5-48. This article is adapted from the above and gives an account of the systematics, habits and habitats, transformation, use, dissolving of the shell, etc. of Cowries which are so well known to mankind.

The Cowries are marine molluscs which constitute the well-known family Cypraeidae. There is no group in Mollusca which appears to have excited more curiosity and admiration than the Cowries. These forms present remarkable variety of colouration and markings as well as sculpture on their shells in close harmony with the corals, which are really objects of great beauty and delight. The changes which the shells exhibit regarding form and colour at different phases of their growth are so striking and dissimilar that it is difficult to find out the true link between them unless carefully studied from the very beginning. This is how the naturalists and scientists in early days got puzzled and wrongly treated the young and adult of the same species as belonging to different forms. The animal is also gifted with the curious faculty of dissolving or decomposing (with its acetose juices) any portion of the shell that is liable to resist the advancement of its growth, and of renewing it. It may take time for a cowry to attain its full development, but the re-calcification of a shell at a maturer age is said to be the work of a few days only. These may be the facts which possibly created an unusual interest in men to study the cowries, to utilize the animal as food or otherwise and also to use their shells (mainly composed of carbonate of lime secreted by the mantle itself) for the purpose of decoration, ornamentation, games, defence, etc.

SYSTEMATICS

The admirable contributions of Lister (1685—*Hist. Conchyl.*) Rumphius (1705—*Amb. Rarit. Kam.*), Petiver (1711—*Gazophyllacium* Vol. I), Gualtieri (1735—*Index Test. Conchyl.*), Adanson (1757—*Hist. Nat. Senegal Coq.*) and others on the iconography of cowries and other shells appear to have evoked considerable interest in the study of molluscs in the 17th and 18th century and thus helped conchology in gaining more popularity and confidence as an important subject among the natural sciences. But the real work on the systematics of cowries was started with the introduction of binomial nomenclature by Linnaeus in his *Syst. Nat.* ed. X, 1758, which placed them under the new generic name of Cypraea (p. 718). It is perhaps so named, says Perry (1811—Conchology), 'from the circumstance of a beautiful shell of this genus, having, as it is said, been presented to the temple of Venus at Cyprus—a luxuriant and smiling island in the Mediterranean teeming with industrial wealth; and, indeed, the beauty and splendour of these shells render them worthy of being offered at the shrine of the Goddess of Beauty'. Dr. J. C. Melvill in his comprehensive work on cowries published in *Mem. and Proc. Manchest. Lit. and Phil. Soc.* Ser. 4, Vol. I, pp. 184-185 (1888) gives plausible explanations of this important usage. It was Fleming (1828) who took keen interest in the study of cowries and erected the new family Cypraeidae for their reception. But unfortunately he failed to separate them from the smaller Nun cowries which also live in close association with the former in the sea. However, this difference of great taxonomic value was detected before long by Gray, in 1832, on the basis of which he separated the Nuns entirely from *Cypraea* and instituted the new genus *Trivia* for their accommodation in his Descriptive Catalogue of Shells. Now, the 'Trivias', like the cowries, have also been given a separate family rank (Triviidae) owing to the remarkable features noticeable in their shell-characters, i.e. there are fine transverse ribs (Pl. I, Fig. 5, tr. r.) on the surface of their shells (the anterior and posterior ones being vertical) which are interrupted in the middle by a longitudinal groove (m. gr.); these ribs are nothing but mere prolongations of the denticulations (Fig. 6, d.) found on the lips below (o.l., o.l.).

Linnaeus described only 42 species of cowries in his *Syst. Nat.*, pp. 718-725, under the single genus *Cypraea.* But as a result of extensive studies in the field in the course of about 200 years the number of species of living Cypraeidae has now risen nearly to 170 with more than 250 subspecies under them relegated to 56 or more genera and 13 sub-families. The works published by Kiener (1843—*Icon. Coq. Viv.*), Reeve (1845-1846—*Conch. Icon.* Vol. III), Sowerby (1870—*Thes. Conchyl.* Vol. IV.), Weinkauff (1881—Martini and Chemnitz's *Conch.-Cab.* Vol. V, Abth. 3) and Roberts (1885—in Tryon's *Man. Conch.* Vol. VII) are illustrated with beautiful diagrams bearing natural colouration and markings which help in the identification of the cowries, while those by Hidalgo (1904-1905—*Test. Moll. Filipinas;* 1906-1907—*Mém. de la Real Acad. Cienc. Madrid,* XXV) refer to zoogeography and other details. But the most up-to-date and comprehensive work on the subject is that of Schilder and Schilder (*Proc. Malac. Soc. London,* Vol. XXIII, pp. 119-231, 1939) which shows marked improvements in the nomenclature and classification of cowries. It is astonishing to learn that while completing that monumental work the distinguished couple spared no pains to examine about 60,000 shells or more of living Cypraeidae obtained from more than 2,200 localities, and consulted about 2,500 papers. This not only shows their tenacity and devotion to work, but at the same time displays the extent of the subject, its richness of literature and the great interest it has created in the public as well as in the scientific mind since very early times.

HABITS AND HABITATS

The cowries are very shy, hardy and sluggish creatures which occur in great abundance on the submerged rocks and coral reefs of our shallow seas to feed chiefly on coral animals and other micro-organisms. Like the shell, the mantle (which Rutherford Platt[1] considers as 'a bait of animated skin') is also variegated with colours. Its two thin, unequal lobes with frilled margins come outside through the long and narrow aperture of the shell (s.), extend over its dorsal surface on both the sides and cover it either partially or wholly. This peculiar contrivance serves two very useful purposes; firstly, to save the shell and the animal from the attack of enemies, and, secondly, to attract other organisms forming its food. Woodward in his Manual of the Mollusca (1856) mentions that Adams observed the pteropodous fry of *Cypraea annulus* adhering in masses to the mantle of the parent, or swimming in rapid gyrations or with abrupt jerking movements by means of their cephalic masses.

It is true that the cowries have now mostly disappeared from the cold waters of the European seas, but as Stoliczka points out (Cret. Faun. S. Ind. II, p. 51, 1868): 'there is ample evidence, that they were formerly very numerous in the Vienna, Paris, and other districts or basins'. Their presence in large numbers in the warm seas of the tropics at the present time shows that they have found sufficiently encouraging and congenial climatic conditions to carry on their normal life and activities. There might be some reasons responsible for this wonderful upheaval or upset in the faunal development which adversely affected the ecological conditions so favourably influencing the life, growth and proliferation of this shellfish in the European seas. At present the range of distribution of the cowries appears to be confined mostly to the warm waters of the tropics extending from the Persian Gulf, Gulf of Oman, Gulf of Aden, Red Sea, Arabian Sea (including the east coast of Africa) on the west and thence *via* Indian Ocean, Gulf of Manaar, Bay of Bengal as far as Hawaii or even beyond in the Pacific on the east. Geologically speaking, the cowries commenced in the Cretaceous, but have largely augmented in the number of species at the present time. One species is also recorded from the Upper Jurassic of Sicily. It is interesting to note here that in pre-historic graves in the Baltic countries and elsewhere one finds cowries along with other shells and animal remains discovered by archaeological explorations, which undoubtedly proves the antiquity of their close connection with human culture and civilization. Specimens of *C. annulus*, as stated by Woodward (p. 121), were found by Dr. Layard in the ruins of Nimroud. Furthermore, records from pyramids and tumuli show that both the dark queens of the east and fair princesses of the north clasped some favourite pearls or cowries as they were laid to their eternal rest.

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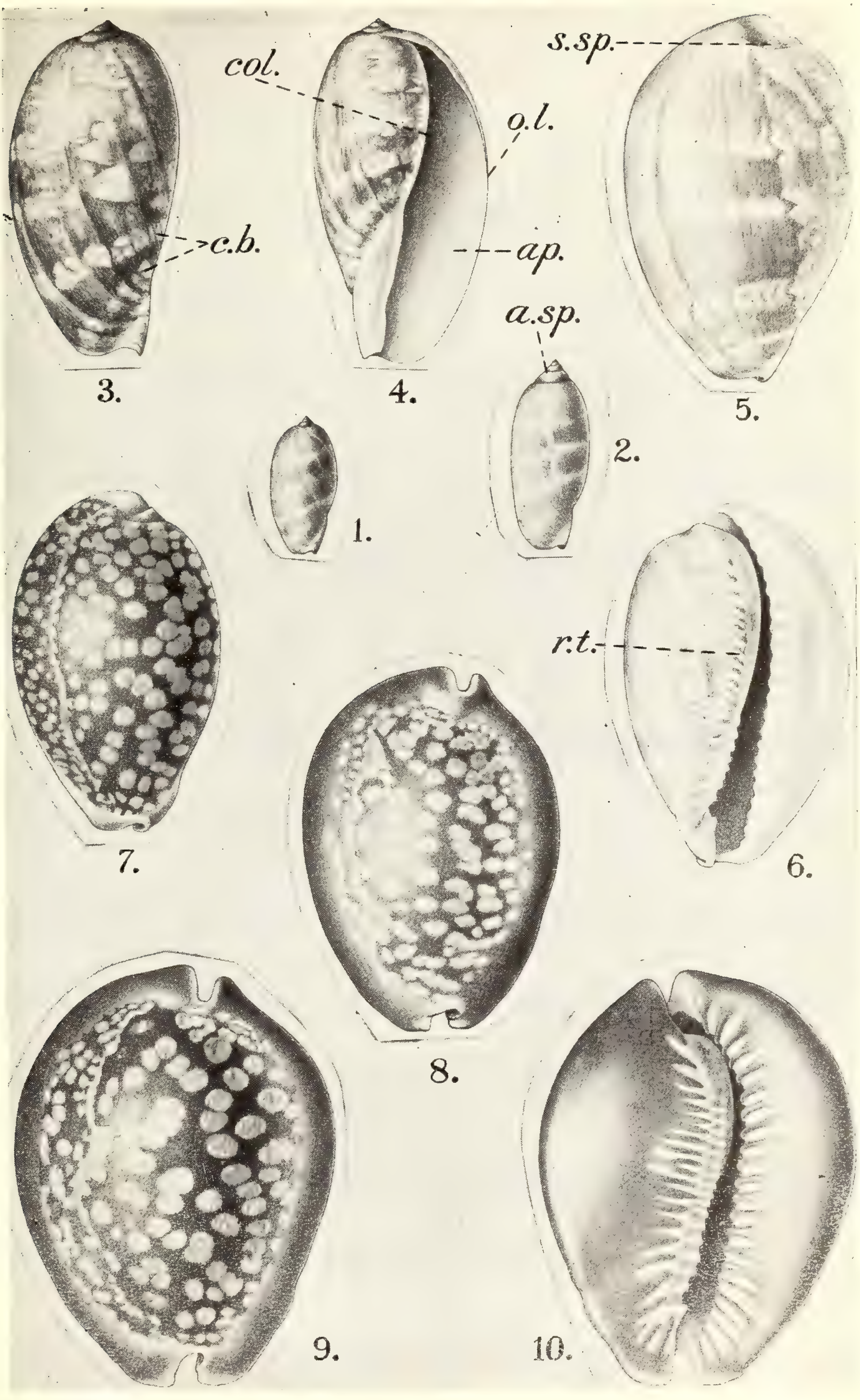
[1] Platt, R. *Nat. Geogr. Mag.* XCVI, No. 1, July, p. 39 (1949).

TRANSFORMATION

The cowry shells undergo such wonderful changes both of form and colour at different phases of their growth that they at once remind us of the remarkable phenomenon of metamorphosis in insects and *Leptocephalus* (the larva of eel). The different stages are diagrammatically shown in Plate II as observed in a series of shells of *Mauritia mauritiana* (Linn.) available in our named collections. The first stage of development begins with a simple convolution of the shell around the columellar axis in the form of a long drawn-out bulla and hence the name 'Bulla-state' (Figs. 1-4). It is chiefly characterized by a depressed or acuminated spire (a. sp.), long and wide aperture (ap.), smooth and rounded columella (col.) or inner lip appearing somewhat twisted and curved anteriorly, thin and curved outer lip (o. l.) and attractive colouration and markings usually diffused in bands (c. b.) or wavy lines. But sometimes very fine and delicate striations are also found on the inner lip which extend for some distance over the dorsum. In the second epoch of growth the shell (Figs. 5, 6) gradually solidifies, the spire begins to sink below (Fig. 5, s. sp.), the outer lip and columella begin to thicken and consequently the aperture becomes narrowed, the rudimentary teeth (r. t.) make their appearance on the lips from below upwards and the dorsal surface becomes overlaid with a strong coat of gorgeous colouring matter, also diffused in obscure bands or waves. Later the shell (Fig. 7) becomes ventricose with the sides more thickened, the teeth more strengthened, the aperture more narrowed and the acuminated spire completely absorbed or remaining only rudimentary in some cases. Finally the growth of the shell is completed by a light fabric of colouring matter deposited in lines, blotches, waves or reticulations of various hues and pattern (Figs. 8, 9). The ornamental character with which the dorsal surface is usually painted appears to be the last effort, says Reeve, in the formation of the shell, but that does not appear until the latter is on the eve of maturity, the most richly variegated layers of enamel are reserved for the final decoration. *Cypraea mappa* happens to be an exception to this general rule, because a layer of pale hieroglyphical painting greatly resembling that of *C. arabica* is deposited here by the animal on the left side chiefly when yet in a very immature state of growth. On arriving at maturity another richer layer of the same pattern is superimposed on the former. Thus the shell in the 'Bulla-state' looks so unlike the adult as to give little clue to its affinities with the latter. Reeve has given a few interesting examples showing the different stages of growth of the shell from the bulla-state to the adult form and I am also adding a few more in my work on the revision of cowries.

USES

The importance of cowries has been realized by men in various fields, of which the most remarkable is their use as a medium of exchange (replacing the old barter system). This practice which was so exceedingly common amongst the civilized and uncivilized people in all parts of the globe and developed into flourishing trade and commerce has not yet completely died out. One of the commonest species thus


s.sp.
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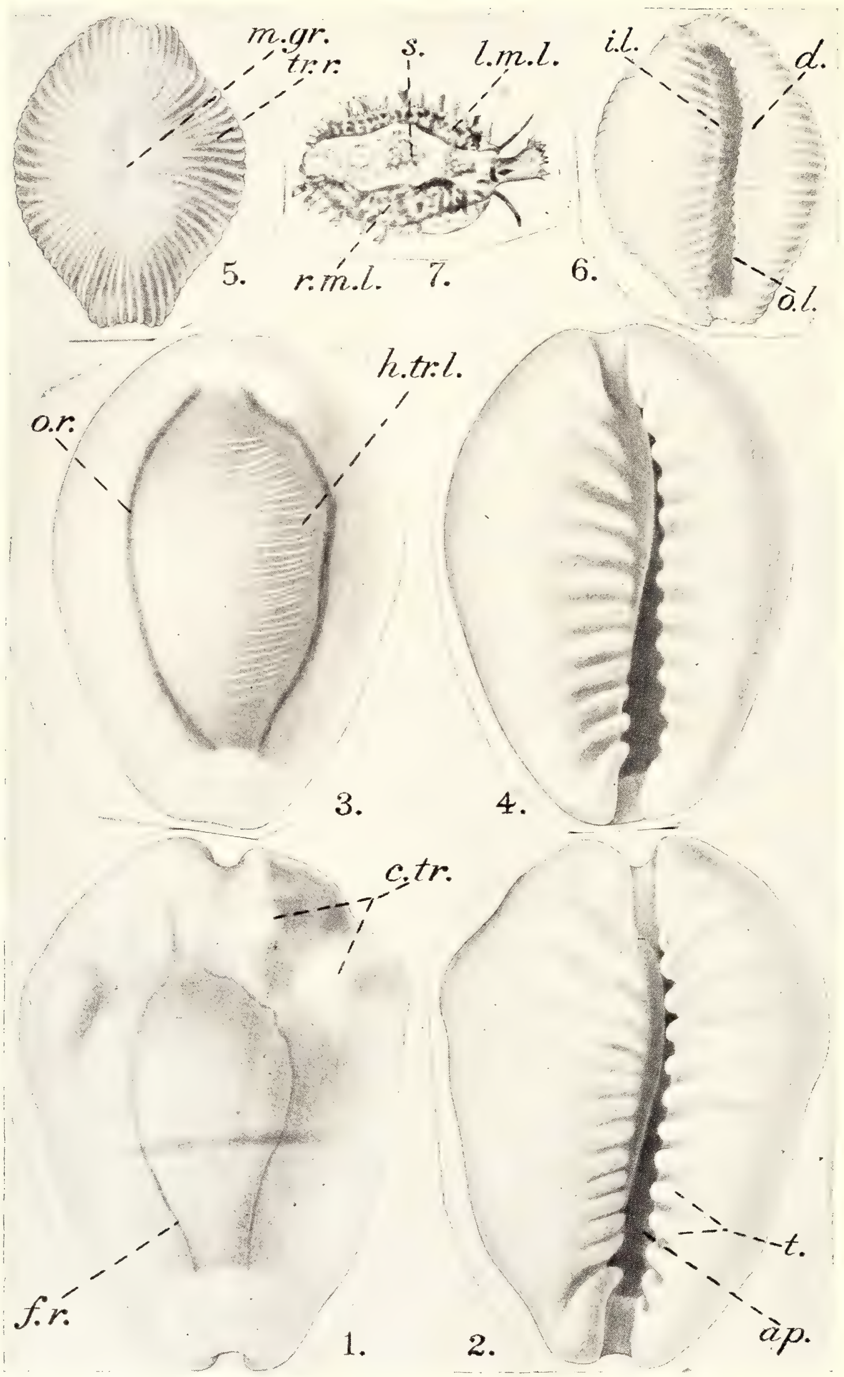
A. K. Mondal, del.

Transformation of shell in *Mauritia mauritiana* (Linn.)


m.gr.
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s.
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A. K. Mondal, del.

employed was 'money-cowry' or 'prop-shell', *Monetaria moneta* (Linn.), which stands almost alone in being used entire (Pl. I, Figs. 1, 2), while all the other forms of shell money are made out of portions of the shells and thus entail more time, labour and care. This species can easily be distinguished by its thick, strong, triangularly-ovate shell of whitish to pale yellowish colour (sometimes with a bluish tint) bearing callous dorsal tubercles (c. tr.) of varying size and a faint ring (f. r.). The teeth are mostly extended and tuberculated, especially posteriorly. These peculiarities which are so simple and easy to detect, but not so readily subject to erosion and decay (excepting colouration), perhaps led the early people to select this particular type as currency. *Ornamentaria annulus* (Linn.) or 'ring-cowry', as it is commonly called, is another species (Pl. I, Fig. 3) which is none the less important than its ally, *M. moneta,* and is always found in close association with the latter in the sea. It is more extensively used as ornaments than as currency, as the generic name *Ornamentaria* indicates, but lacks entirely the dorsal tubercles, though it possesses a well-defined orange-ring (o. r.) instead. This possibly earns for it the popular name 'ring-cowry'. Some very fine hair-like transverse white lines (h. tr. l.) are also found within the ring. Shells of this type are known to have been used as ornaments in Oceania, but have also been disseminated for centuries through Southern Asia, Southern Europe and finally to America.

Marco Polo, the well-known Italian adventurer and explorer who wrote an excellent account of the Chinese culture and civilization after his memorable voyage to China, relates finding cowries circulating as currency in Yunnan in the thirteenth century. In a Hindu treatise of 700 A.D. mention is also made of the use of cowries as money. Owing to similar use almost exclusively in some parts of Africa, the cowry trade flourished greatly. This encouraged the despatch of several cargoes of cowries annually to Wydah and Lagos, fished from the Maldive and Laccadive Archipelagoes in the Arabian Sea. In Africa they were exchanged with the slave traders for the Spanish doubloons they received from the sale of slaves. This mean but profitable trade continued till the Brazilians stopped the introduction of African slaves into their country. Till not long ago cowries were imported from India and other places into England to be paid to the natives of W. Africa in exchange for their products. In countries near the Niger, excepting N. Ashantee, prevailed a peculiar system of exchange of gold dust and the gera or cola-nut (*Sterculia acuminata*) with the cowries. A load of sixty pounds of the nuts was considered equivalent in value to fifteen thousand cowries. Another golden opportunity came for the cowry trade when the Sultan of Borneo reformed his currency and introduced the Spanish doubloon (in place of the cotton-cloth, which had hitherto been the medium of exchange) with cowries at the rate of four thousand to the doubloon for small change.

Besides use as currency, there is plenty of evidence in the Ayurvedic literature relating to the medicinal value of cowries. The Hindu women in some parts of our country look upon cowries, especially *Monetaria moneta* and *Ornamentaria annulus,* with veneration as a symbol of wealth and prosperity and, as such, never allow any important social functions, like marriage, 'puja', giving of rice to the mouth of the child ('annaprasana'), sradha, etc. to be performed without these shells. It is also customary with the Hindus of our country to offer some cowries with the corpse. Gambling with cowries, though an ancient and popular pastime, is still in vogue.

The rarer species of cowries, such as *Cypraea umbilicata* and *C. guttata,* are known to fetch high prices sometimes, like the sacred Chanks or 'Sankha', *Xancus pyrum* (Linn.). Similarly, the golden cowry (*C. aurantium* Gmelin) of the South Pacific, which is considered as most precious and a shell of ancient lineage, is highly prized by shell collectors for its beautiful golden colour and also because of the great prohibition imposed upon its export by Government. This is said to be used only by a chief of the islanders as a symbol of his sovereignty, akin to a crown. Chaplets and belts made of cowries are used by some people, especially the islanders and tribals in their traditional gala dance during festivals or while wooing their lovers as described by Platt in his fascinating article 'Shells take you over world Horizon' (p. 38). Somewhat similar adornments are also made on cattle in many parts of India. Various kinds of weapons can be made out of the shells of cowries for the purpose of defence. That a good quality of lime can be produced from these shells is also quite well known. The Asiatic Islanders are said to use the shells of *O. annulus* to weight their fishing nets. The animal of *C. tigris* is said to be used as a bait for cuttle-fishes. The cowry shells are also known to be used as a charm against evil eye and for other magical purposes. It is for all the above and other reasons that cowries probably proved more and more useful to human society and became most intimately connected with its culture and civilization.

Dissolving of the Shell

It is known that *Cypraea* possesses, upon emergency, the extraordinary power of dissolving and renewing its shell. An interesting note about this fact based on personal observations was communicated by Lieut. J. B. Hankey of the British Navy (H.M.S. 'Collingwood', August 6th, 1844) to Reeve who published it in his Elements of Conchology (p. 38, 1863): 'Will you allow me to offer you a few remarks on the habits of the *Cypraea* as regards the fact of its making a new shell, at an advanced stage, of which process I have been myself in more than one instance an eye-witness? I have seen the Cowry crawl into some hollow or sheltered place, evidently for some predetermined purpose. The growth of the animal appears to increase too large for its cell; it gradually swells and cracks the shell, and I think that some powerful solvent or decomposing fluid is distributed over the outer surface by the mantle of the fish, for it gets thinner in substance, and the colours duller in appearance. The shell then entirely disappears, the Cowry becomes to all appearances, a naked mollusk, with no other covering than its membranous mantle, and in a short time secretes a thin layer of glutinous matter which in a few days obtains the fragile consistency of shellac. From this step its growth is more rapid, and it becomes more and more consolidated into the adult shell. When in the first stage of renewal it has the appearance of shellac; it is always the Cymba form, but I have never succeeded in preserving any specimens in this state on account of their extreme fragility'.

The contributions of several workers have added much to our knowledge of the systematics, use and distribution of the Cowries. But I think more attention should be given now to a detailed study of their bionomics and life-history, fishing and fishery, which may unravel many interesting points helping towards a better understanding and utilization of the animals of this group.

I am grateful to Rai Bahadur Dr. S. L. Hora, Director, Zoological Survey of India, for going through the manuscript very critically and making valuable suggestions. My thanks are also due to Sree A. K. Mondal, an artist of the Zoological Survey of India, who has drawn the diagrams with care.

EXPLANATION OF PLATES

Plate I:

Fig. 1. Dorsal view of the shell of *Monetaria moneta* (Linn.) or 'money-cowry' showing the callous dorsal tubercles (c. tr.) and the faint dorsal ring (f.r.). ×3.

Fig. 2. Ventral view of the same showing the long, narrow aperture (ap.) and the teeth (t.), the posterior ones of which are extended and tuberculated. ×3.

Fig. 3. Dorsal view of the shell of *Ornamentaria annulus* (Linn.) or 'ring-cowry' showing the well-defined orange ring (o.r.) and the fine hair-like transverse white lines (h. tr. l.). ×3.

Fig. 4. Ventral view of the same showing the aperture and the simple teeth. ×3.

Fig. 5. Dorsal view of a Nun Cowry, *Trivia* (*Trivirostra*) *oryza* (Lamk.), showing the fine transverse dorsal ribs (tr.r.) and the median longitudinal groove (m.gr.). ×6.

Fig. 6. Ventral view of the same showing the aperture and the transverse dorsal ribs continuous with denticulations (d.) on both the inner and outer lips (i.l., o.l.). ×6.

Fig. 7. Right and left mantle lobes (r.m.l., l.m.l.) partially covering the shell (s.) dorsally. (After Steadman and Cotton).

Plate II:

Figs. 1-4. 'Bulla-state' of *Mauritia mauritiana* (Linn.) showing the acuminated spire (fig. 2, a. sp.), smooth and rounded columella (fig. 4, col.) or inner lip somewhat twisted and curved anteriorly, thin and curved outer lip (o.l.), long and wide aperture (ap.) and the dorsal colour bands (fig. 3, c.b.). Nat. size.

Figs. 5 & 6. A shell of the same (dorsal and ventral view) in the second epoch of growth with sinking spire (fig. 5, s. sp.), narrowed aperture caused by thickening of both the lips bearing rudimentary teeth (fig. 6, r.t.) developed from anterior to the posterior end. Nat. size.

Fig. 7. A shell of the same showing the appearance of adult colouration and markings as well as the thickening of the margins and extremities. Nat. size.

Fig. 8. A shell of the same attaining maturity. Nat. size.

Figs. 9 & 10. A fully mature shell of the same (dorsal and ventral view) with characteristic shape humped dorsum ornamented with beautiful colouration and markings (fig. 9.), well-developed teeth and greatly sinuous aperture only posteriorly (fig. 10). The acuminated spire, one of the most prominent features of the bulla-state, disappears here completely. Nat. size.

ON A COLLECTION OF FISH FROM THE ANAMALAI AND NELLIAMPATHI HILL RANGES (WESTERN GHATS) WITH NOTES ON ITS ZOOGEOGRAPHICAL SIGNIFICANCES

BY

E. G. SILAS, B.SC. (HONS.)

(Communicated by Dr. S. L. Hora)

(*With a plate and two text maps*)

INTRODUCTION

Our knowledge of the fish fauna of the Anamalai and Nelliampathi hill ranges lying immediately south of the Palghat Gap is very scanty. Considerable importance has been attached in recent years to the Palghat Gap as a probable barrier in the distribution of torrential fishes along the Western Ghats. Zoogeographical studies have revealed that this gap, in the otherwise continuous mountain ranges, has had profound effects on the southward distribution of certain forms of animals. Situated 10°46′ N and 72°42′ E, Palghat lies within the Malabar region. Day (1865) in his 'Fishes of Malabar', Blanford (1901) in his classical work on the distribution of Indian vertebrates, Annandale (1911) in his account of the fresh water sponges and polyzoa in India, and Prashad (1942) in his systematic survey of the zoogeographical evidence afforded by the distribution of various groups of Indian animals have all recognized the importance of treating the Malabar zone as a distinct biogeographic entity. Hora in his several contributions on the geographical distribution of freshwater fishes in India and adjacent lands has indicated the likely migratory highroads of the torrential fishes along the various mountain trends. As evidenced by the distribution of freshwater fishes along the Western Ghats, Bhimachar (1945) has divided the Ghats into three divisions, *viz.*, a Northern Division, comprising the Deccan Trap area from the Tapti river down to 16° N latitude about the level of Goa; a Central Division, extending from 16° N latitude southwards and including the Malnad parts of the Mysore State, Coorg, Wynaad, parts of South Kanara district and the Nilgiris; and a Southern Division, comprising the Anamalai, Palani and Cardomom hills of Travancore. The Palghat Gap thus forms the dividing line between the Central and the Southern Divisions.

Though considerable work has been done on the fish fauna of the Central Division in recent years, the regions immediately south of the Palghat Gap have remained practically unexplored. What little we know about the fishes of this region, we owe to the work of Day (1865) and more recently to that of Herre (1942, 1945). After his visit to India in 1941, Herre reported the discovery of two new fishes from the Anamalai Hills, one a sisorid catfish *Glyptothorax housei* Herre, and the other a homalopterid, *Homaloptera montana* Herre. In addition he extended the distribution of the remarkable homalopterid *Travancoria jonesi* Hora, previously known only from the hill ranges of northern and central Travancore, to the Anamalai Hills in the north. The bedrock of Zoogeography being intensive systematic studies, an extensive collection from this region was found to be wanting. On the suggestion of Dr. Hora, therefore, the author visited and made fish collections from places south of the Palghat Gap lying in the Coimbatore, Malabar and Cochin districts. The specimens forming the basis of the present paper were collected during the months of April and May 1950.

TOPOGRAPHY OF THE AREA

OROGRAPHY

The Anamalai and the Nelliampathi hill ranges lying in an east to west direction have an average altitude of about 3,500 to 4,500 ft. Though well within the tropics they have a temperate climate. Like most of the isolated hill tracts of the peninsula, these hills arise abruptly from the lower country around them and are bounded on all sides by short precipitous spurs—the remnants of a former great escarpment. To the north of these, separated by the Palghat Gap and the extensive plains of Coimbatore District, lie the Nilgiri Hills. The intervening plains of the Palghat Gap at no place rise to anywhere near a thousand feet and hence

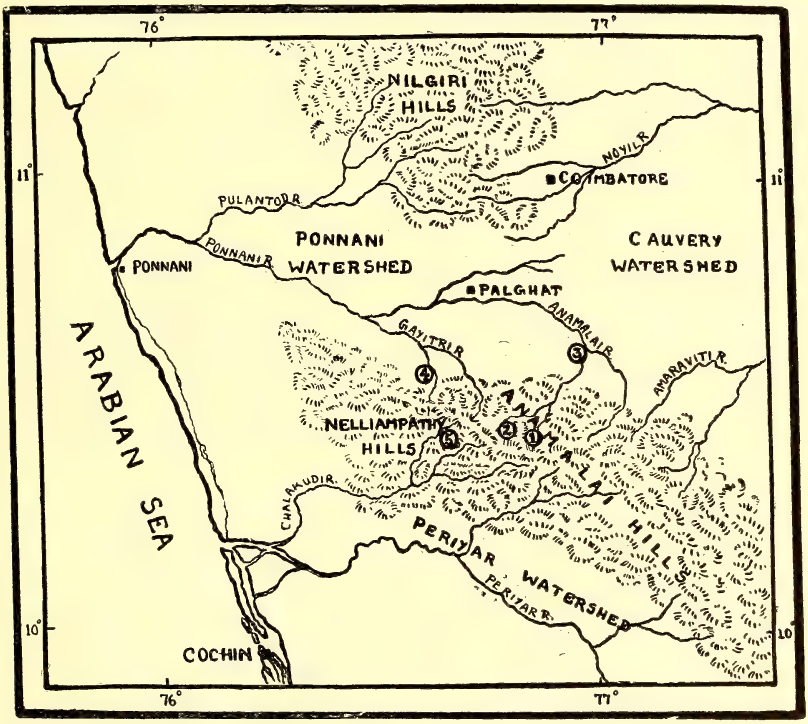

76°
77°
NILGIRI HILLS
NOYIL R.
COIMBATORE
11°
11°
PULANTODE R.
PONNANI WATERSHED
PONNANI R.
PONNANI
CAUVERY WATERSHED
PALGHAT
ANAMALAI R.
GAYITRI R.
AMARAVATI R.
ARABIAN SEA
4
3
NELLIAMPATHY HILLS
5
2
1
ANAMALAI HILLS
CHALAKUDI R.
PERIYAR R.
PERIYAR WATERSHED
PERIYAR R.
10°
10°
COCHIN
76°
77°

Fig. 1

Map showing the hill-ranges, the drainage systems and the localities from where collections were made immediately south of the Palghat Gap.

1. Puthutotam Estate: 2. Stream beyond Valparai town, Anamalai Hills; 3. Stream at base of Anamalai Hills; 4. Stream at Nemmara; 5. Streams in the Manalaroo Estate, Nelliampathy Hills.

the abrupt high ranges on either side help to stop both the North-east and South-west Monsoon clouds and precipitate moisture in the hills closeby. Meteorological records show that these hills receive an annual maximum rainfall of about 200 inches.

DRAINAGE SYSTEM

Great importance must be attached to the nature of the watershed in a given place in discussing the distribution of freshwater organisms, especially fishes, as fortuitous dispersal of hillstream fishes through any agency whatsoever must be a very rare occurrence. The streams of the Anamalai and the Nelliampathi hill ranges and of the areas in their immediate vicinity drain ultimately into three main systems, namely, the Cauvery, the Ponnani and the Periyar.

The Cauvery Drainage

The Cauvery is fed by a number of streams arising in the Central Division of the Western Ghats, viz., the hills of Coorg, Mysore and the Nilgiris. On the east of the Anamalai Hills, a tributary of the Amaraviti originates and flows due east and then joins the Amaraviti, which in turn joins the river Cauvery further east. The Cauvery thus links up the eastern faces of the Ghats in the Central and the Southern divisions. No collection was made from the Cauvery watershed.

The Ponnani Drainage

The rivers Anamalai and Gayitri which take their origin from the eastern slopes of the Anamalai and Nelliampathi hill ranges respectively, flow in a north-west direction before turning due west and eventually joining the river Ponnani which empties itself into the Arabian Sea. The river Ponnani also receives a number of tributary streams from the Nilgiri and the Wynaad hills. The Ponnani watershed drains the western face of the Ghats of the Central Division and the eastern face of the Ghats of the Southern Division.

The Periyar Drainage

The streams and rivers on the western and south-western faces of the Anamalai and Nelliampathy hills are separated from the watersheds of the north-eastern face by the intervening high hill ranges. The river Chalakudi receives a tributary each from the Anamalai and Nelliampathi hills, flows due south-west and joins the river Periyar close to the sea in Cochin. The Periyar river is fed by a number of streams draining the western face of the Anamalai Hills in the north and the Cardamom Hills in the south. The Periyar watershed though isolated from the north, is continuous with the system of waterways further south.

The Cauvery and the Ponnani watersheds which connect the Central and the Southern divisions are likely to facilitate the dispersal of fishes from the north to the south. But unfortunately we do not know anything of the fish fauna of the tributaries of the Cauvery draining the Southern Division of the Western Ghats. The collections dealt with here from the Ponnani watershed shows the co-mingling of the species hitherto recorded from the Central and the Southern divisions. The collection from the Periyar watershed is not representative enough for drawing any conclusions from.

DESCRIPTION OF LOCALITIES AND LIST OF FISHES COLLECTED THEREFROM

The Ponnani Drainage System

Anamalai Hills.—As many as 21 species were collected from the streams and tanks in the Anamalai Hills and their immediate vicinity. First the author visited the coffee plantation of Puthutotam Estate, situated at an elevation of 3,600 feet in the Anamalai Hills. Collections were made from a shingly stream and a tank in this estate. The stream is springfed and perennial. Plenty of shade is afforded by the dense vegetation on either bank of the stream. Fallen and decaying leaves collected at various places along the stream harboured myriads of aquatic insects. A few loaches were obtained from underneath stones and from certain muddy patches. Most of the fish were collected from the numerous rocky pools.

The tank, which is situated at a higher elevation, had a surface area of about an acre at the time of collection. Part of the tank was found to be overgrown with long grass and waterweeds (Nymphaceae). Being springfed, it contains water all the year round. The water from the tank is utilised for drinking purposes and the excess outflow is passed through a wire netting.

The following is a list of the species collected from the tank and the stream:—

Name of species	No. of specimens	Standard length
Rasbora daniconius (Ham.)	... 3	55·5—76·0 mm.
Barilius gatensis (Cuv. & Val.)	... 1	102·0 ,,
Danio aequipinnatus McClelland	... 4	41·0—62·0 ,,
Barbus (*Tor*) *khudree malabaricus* (Jerdon)	... 1	149·0 ,,
Barbus (*Puntius*) *melanampyx* Day	... 5	30—54 ,,
Garra mullya (Sykes)	... 6	53—93 ,,
Lepidocephalus thermalis (Cuv. & Val.)	... 3	43—60 ,,

Another collection was made from a large stream a few miles beyond Valparai town in the Anamalai Hills. This stream flows along the southern boundary of the Mudis group of estates and at the time of collection was over 70 feet wide. The stream was fast-flowing and had a number of large pools at intervals, with plenty of boulders and stones along its course. There was dense vegetation on either bank. Fish life was found to be scarce in this stream. On enquiry it was found that the depletion in numbers was mainly due to the large scale poisoning of the stream by some miscreants a few days prior to the writer's visit. Destructive elements, such as copper sulphate, Bordeaux mixture and dynamite, were said to have been used for this purpose.

The writer was able to collect the following species from this stream:—

Name of species	No. of specimens	Standard length
Rasbora daniconius (Ham.)	... 2	57—71 mm.
Barilius gatensis (Cuv. & Val.)	... 1	88 ,,
Barbus (*Puntius*) *carnaticus* (Jerdon)	... 9	128—302 ,,
Barbus (*Puntius*) *melanampyx* Day	... 4	38—62 ,,
Barbus (*Tor*) *khudree malabaricus* (Jerdon)	... 3	126—221 ,,
Garra mullya (Sykes)	... 1	33 ,,

A number of specimens were obtained from the pools and the flowing waters of a large stream at the base of the Anamalai Hills. The water was fast-flowing and a number of small rapids and falls were present in the stream. Vegetation was sparse on either bank. A long distance along the banks of this stream was traversed and collections were made from different niches.

A great majority of the species were obtained from three large pools in the stream near Vannamadi Bridge.

The following species were obtained from this stream:—

Name of species	No. of specimens	Standard length
Chela argentea Day	4	63—78 mm.
Barilius barana Ham.	1	45·5 ,,
Danio aequipinnatus McClelland	14	41—65·5 ,,
Rasbora daniconius (Ham.)	1	51·0 ,,
Barbus (*Puntius*) *amphibius* (Cuv. & Val.)	1	86·0 ,,
Barbus (*Puntius*) *carnaticus* (Jerdon).	2	109–176 ,,
Barbus (*Puntius*) *carmuca* (Ham.)	5	44—87·0 ,,
Barbus (*Puntius*) *dorsalis* (Jerdon)	1	48·0 ,,
Barbus (*Puntius*) *dobsoni* Day	1	69·0 ,,
Barbus (*Puntius*) *melanampyx* Day	8	31—56·0 ,,
Barbus (*Puntius*) *ticto* (Ham.)	4	52—55 ,,
Barbus (*Tor*) *khudree malabaricus* (Jerdon)	1	114·0 ,,
Garra mullya (Sykes)	8	89–107 ,,
Osteochilus (*Osteochilichthys*) *thomassi* (Day)	5	57–196·0 ,,
Nemachilus triangularis (Day)	2	53—71·5 ,,
Lepidocephalus thermalis (Cuv. & Val.)	2	51—62·0 ,,
Batasio travancoria Hora & Law.	4	90—93 ,,
Glyptothorax madraspatanus Day	2	50·25—63·25 ,,
Ophicephalus gachua (Ham.)	1	65·0 ,,
Mastacembelus armatus (Lacep.)	2	70—76 ,,

Nelliampathi Hills.—A few species were collected from a small stream and a tank in the vicinity of Nemmara, close to the Nelliampathi Hills. Due to the failure of the regular monsoon the level of water in the tank had gone down considerably. One side of the tank received more shade from the overhanging branches of the trees that fringed that part of the bank. The stream had a sandy substratum.

The following species were collected from here:—

Name of species.	No. of specimens.	Standard length
Chela clupeoides (Bloch)	5	72—91 mm.
Danio aequipinnatus McClelland	4	31—67 ,,
Rasbora daniconius (Ham.).	3	48—55 ,,
Barbus (*Puntius*) *amphibius* (Cuv. & Val.)	7	89—112 ,,
Ophicephalus gachua (Ham.).	2	58—62 ,,

The Periyar Drainage System

Nelliampathi Hills.—In May (1950), the author visited and made fish collections from the streams and pools in the Manalaroo and neighbouring estates in the Nelliampathi hill range. These hills being less extensive and more precipitous than the Anamalais, the streams here flow more abruptly into the plains. Due to the then prevailing drought most of the streams had dried up leaving patches of stagnant water here and there. Collections were made from a few pools and a springfed stream. Intermittent areas of sandy stretches were present in the stream and the water was not very clear. The rate of flow was also slow. Plenty of submerged weeds and debris were present in the sandy stretches. Isolated pockets of stagnant water teeming with mosquito larvae were found in certain places along the course of the stream. Collections were made by bag-nets, and wherever the water was deep enough and free from weeds and submerged debris a cast-net was used.

The following species were obtained from here:—

Name of species.		No. of specimens.	Standard length.
Barilius bakeri Day	...	7	71—91 mm.
Danio aequipinnatus McClelland	...	23	21—81 ,,
Barbus (*Puntius*) *melanampyx* Day	...	18	33—65 ,,
Barbus (*Puntius*) *filamentosus* (Cuv. & Val.)	...	4	67—91 ,,
Garra mullya (Sykes)	...	8	39—88 ,,
Nemachilus triangularis (Day)	...	14	34—56 ,,
Aplochilus lineatus (Cuv. & Val.)	...	3	36—48 ,,
Ophicephalus gachua Ham.	...	1	39 ,,

NOTES ON CERTAIN SPECIES

Barbus (*Puntius*) *carnaticus* (Jerdon)

1942 *Barbus* (*Puntius*) *carnaticus*, Hora, *Rec. Ind. Mus.*, xliv, p. 195.
2 specimens—Tank in Puthutotam Estate, Anamalai Hills; length 142—154 mm.
9 specimens. Large stream 7 miles from Valparai town; Annamalai Hills: length 128—302 mm.
2 specimens. Stream at base of Anamalai Hills; length 109—176 mm.

To *Barbus* (*Puntius*) *carnaticus* (Jerdon) are referred 13 specimens 109 to 302 mm. in length collected from the Anamalai Hills. About the distribution of this species Day observed, 'Found in the rivers along the base of the Nilgiris, Wynnad and South Kanara Hills'. The present collection extends the distribution of this species from the Central Division of the Western Ghats to the Anamalai Hills in Southern Division. It is of interest to note that this species while present in the Ponnani and Cauvery watersheds in the Anamalai and Nelliampathi hill ranges has not so far been recorded from the Periyar drainage and from the rivers further south in Travancore. *B.* (*Puntius*) *carnaticus* grows to a fairly large size and is known to attain over 25 lb. in weight.

Osteochilus (*Osteochilichthys*) *thomassi* (Day)

1877 *Scaphiodon thomassi,* Day, *Fish. India,* p. 551, pl. cxxxiv, fig. 1.
1942 *Osteochilus* (*Osteochilichthys*) *thomassi,* Hora, *Rec. Indian Mus.,* xliv, p. 196. 5 specimens—Streams at base of Anamalai Hills; length 57-196 mm.

This species was hitherto known to occur in the Central Division of the Western Ghats, Bhimachar (1945) speaking of the zoogeographical divisions of the Western Ghats, referred to the genus *Osteochilus,* and stated: 'It is significant that these are absent in Southern Division'. The present collection extends the distribution of *Osteochilus* (*Osteochilichthys*) *thomassi* from the Central to the Southern Division but as is the case of the preceding species, it is not found in the Periyar River drainage system. Attention has already been invited to the common watershed of the streams of the Central and the Southern divisions of the Western Ghats which would explain the distribution of *Osteochilus* to the Southern Division of the Ghats.

Batasio travancoria Hora and Law.

1941 *Batasio travancoria* Hora and Law, *Rec. Indian, Mus.,* xliii, pp. 40-42.
4 specimens—Stream at the base of the Anamalai Hills. Length 90 to 93 mm.

Previously known from southern and central Travancore, the present collection extends the distribution of *Batasio travancoria* north to the Ponnani watershed in the Anamalai Hills. The discontinuity in the distribution of the species of this genus shows its antiquity, for it represents one of the Malayan elements in the fauna of Peninsular India.

Glyptothorax prox. *madraspatanus* (Day).

1941 *Glyptothorax madraspatanus,* Hora and Law, *Rec. Indian Mus.* xliii, p. 255.
2 specimens. Stream at the base of Anamalai Hills. Length 50-25 and 63.25 mm.
D 1/6/0; A 3/6/1; P 1/8; V 6; C 17.

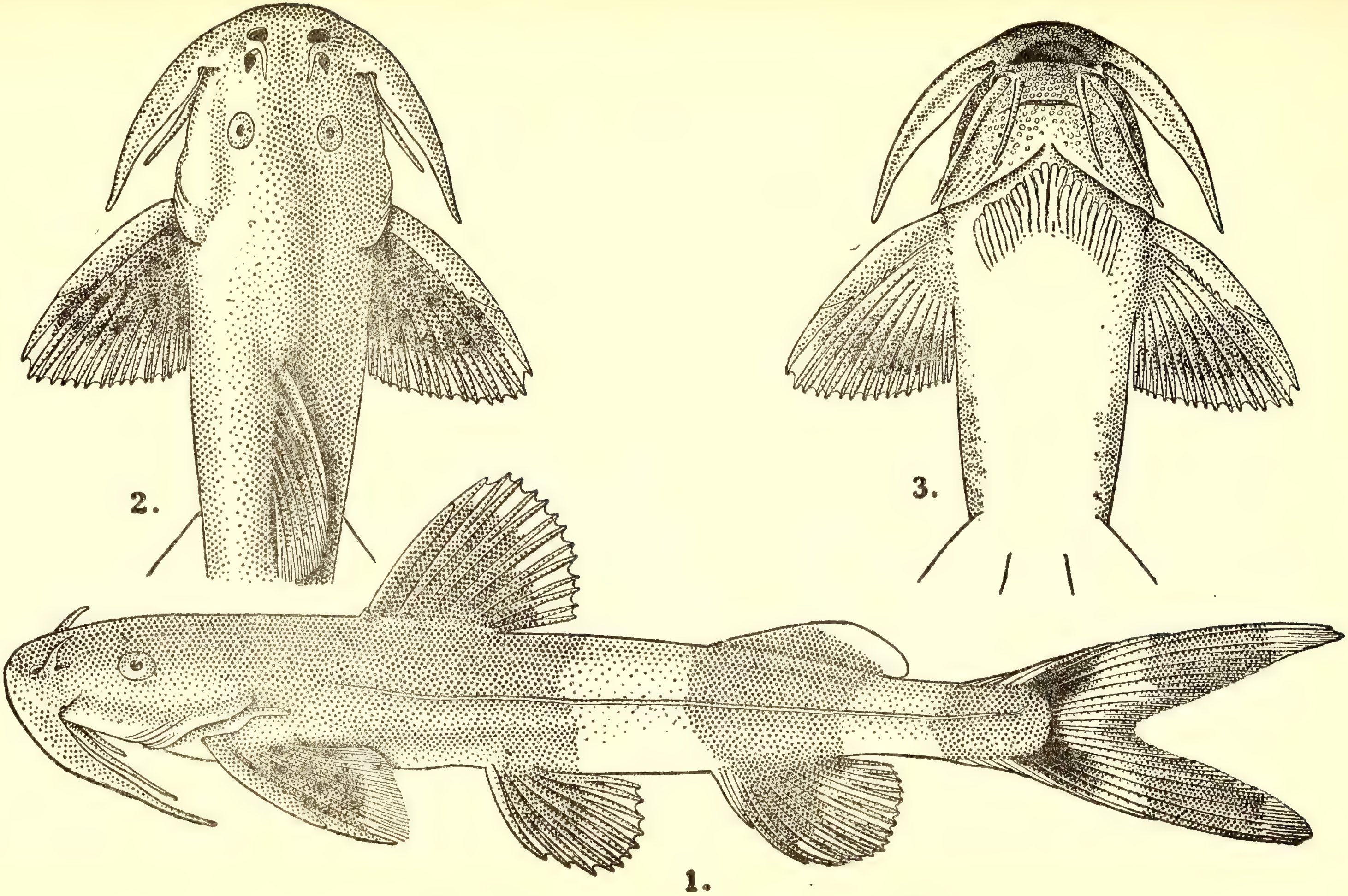
Two specimens of *Glyptothorax* collected from the stream at the base of the Anamalai Hills differ considerably in body colouration from *Glyptothorax madraspatanus* (Day) found in the hill streams of Travancore. These specimens are characterized here as follows:—

The head and the anterior part of the body are considerably depressed, the dorsal profile is slightly arched and the ventral profile flattened and horizontal. The head is slightly longer than broad, but is not as long as 1½ times its breadth. The length of the head is contained 5 times and the depth of the body 6.5 to 8 times in the total length. The eyes are small and placed dorso-laterally, and are not visible from the ventral surface. The length of the snout corresponds to almost half the length of the head and consequently the eyes are placed more in the posterior half of the head. The inter-orbital width is contained 3.25 to 4 times in the length of the head.

The mouth is subterminal. The teeth in the upper jaw are pointed and are placed in a transverse band. The width of the mouth is contained almost three times in the length of the head.

The flattened ventral surface between the pectorals is plaited to form an adhesive organ. The skin on the ventral surface of the outer rays of the pectorals is also corrugated so as to help in adhesion. The maxillary barbels are long and broad at their base. They extend to slightly beyond the base of the pectoral fin. The inner mandibular barbels are shorter than the outer. The gill openings are situated obliquely and extend to the ventral surface for a short distance.

The dorsal arises closer to the tip of the snout than to the base of the caudal. The longest ray of the dorsal is much longer than the depth of the body below it. The dorsal possesses 6 branched rays. The anals are small and possess 3 simple and 7 branched rays. The paired fins are flattened and horizontal. The pectorals are broad and possess eight branched rays. The spine of the pectoral is serrated on its inner edge. The pectorals are separated from the pelvics by



Glyptothorax prox. *madraspatanus* (Day)
1. Lateral view; 2. Dorsal view; 3. Ventral view

a considerable distance. The pelvics commence slightly posterior to the origin of the dorsal and are separated from the anal by a short distance and possess 6 rays. The caudal is long and deeply forked. The least height of the caudal peduncle is contained 2½ times in its length. The vent is situated nearer the base of the caudal than to the pectorals.

The skin is tuberculated. The colour in alcohol is as follows:—The body is dark greyish with the ventral surface and the fins being paler. The adipose fin and the other fins are tipped with white. Three white transverse bands are present on the body, one below the dorsal, the second beneath the adipose dorsal and the third at the base of the caudal. A broad transverse white band is present at the bifurcation of the caudal. The caudal lobes are tipped with white.

Measurements in Millimeters

Total length ...	50.25 ...	63.25
Length of caudal ...	11.0 ...	14.5
Length of head ...	10.25 ...	14.25
Greatest width of head ...	9.5 ...	10.0
Height of head near occiput ...	5.75 ...	5.75
Length of snout ...	5.0 ...	6.0
Inter orbital width ...	3.0 ...	3.0
Depth of body ...	6.0 ...	6.25
Height of dorsal fin ...	8.0 ...	9.0
Length of pectoral fin ...	10.0 ...	11.0
Length of pelvic fin ...	7.0 ...	8.0
Longest ray of anal fin ...	6.75 ...	9.5
Length of caudal peduncle ...	8.0 ...	10.5
Least height of caudal peduncle ...	3.0 ...	3.5
Distance between the tip of the snout and the origin of the dorsal fin ...	15.25 ...	18.0
Distance between the tip of the snout and the origin of the adipose fin ...	26.5 ...	34.0
Distance between the origin of the dorsal and the adipose fin ...	14.0 ...	16.0
Distance between the origin of the dorsal and the base of the caudal ...	24.5 ...	32.0
Distance between the base of the dorsal and the origin of the adipose fin ...	8.75 ...	11.0

ZOOGEOGRAPHICAL REMARKS

Most of the species under report have a wide distribution and hence need no special remarks. The species falling under this category are arranged here under three heads as follows:—

1. *Species widely distributed in India and further East.*

Barilius barana (Ham.)
Danio aequipinnatus McClelland.
Rasbora daniconius (Ham.).
Barbus (*Puntius*) *ticto* Ham.
Ophicephalus gachua Ham.
Mastacembelus armatus (Lacep).

2. *Species common to Peninsular India and Ceylon.*

Barbus (*Puntius*) *amphibius* (C. V.)
Barbus (*Puntius*) *dorsalis* (Jerdon).
Barbus (*Puntius*) *filamentosus* (C.V.)
Barbus (*Puntius*) *melanampya* (Day).
Garra mullya (Sykes).
Lepidocephalus thermalis (C.V.)
Aplochilus lineatus (C.V.)

3. *Species found in the Western Ghats and associated hills.*

Chela clupeoides (Bloch.)	***Barbus*** (***Puntius***) ***curmuca*** Ham.
Barilius gatensis (C.V.)	***Barbus*** (***Tor***) ***khudree malabaricus*** (Ham.)

Glyptothorax madraspatanus (Day).

Of the remaining species, it is significant to note that some, hitherto known only from the Central Division of the Western Ghats and others from Travancore in the Southern Division, are at present found in the drainage system immediately south of the Palghat Gap. The Anamalai Hills are also characterized by the presence of two endemic species. Here, those species which are of zoogeographical importance are arranged under three groups and their significance is discussed.

1. Species hitherto known from the Central Division, and now found to occur in the Anamalai and Nelliampathi Hills:—

Chela argentea Day.
Barbus (*Puntius*) *carnaticus* Jerdon.
Osteochilus (*Osteochilichthys*) *thomassi* (Day).

2. Species previously known from Travancore and now recorded from the Cochin section of the Anamalai and Nelliampathi Hills:—

Barilius bakeri Day.
Barbus (*Puntius*) *denisonii* Day.
Travancoria jonesi Hora.
Nemachilus triangularis Day.
Batasio travancoria Hora & Law.

3. Endemic species:—

Homaloptera montana Herre.
Glyptothorax housei Herre.

Species such as *Chela argentea*, *Barbus* (*Puntius*) *carnaticus* and *Osteochilus* (*Osteochilichthys*) *thomassi*, being not highly adapted to a torrential life, are also found in the streams of the plains and, as such, it may be presumed that these species have found access from the Central to the Southern Division along some of the streams of the plains of Palghat.

The Periyar drainage system being continuous with the streams of the Nelliampathi Hills, it is but natural that species like *Barilius bakeri* and *Nemachillus triangularis* occurring in Travancore should also be found here. The presence of *Barbus* (*Puntius*) *denisonii*, *Travancoria jonesi*, and *Batasio travancoria* in the Anamalai Hills needs further explanation. It is presumed that these species which were originally found here migrated further south to the hills of Travancore prior to the severance of the connection between the watersheds. The subsequent separation of the watersheds resulted in the isolation of these species both in the north and in the south.

Two specimens of *Glyptothorax* (prox *madraspatanus*) collected by the writer from one of the streams in the Anamalai Hills differ. considerably from *G. madraspatanus* found in the hill streams of Travancore. A tendency towards speciation of this sisorid catfish shows that the isolation of the species here has been of recent occurrence. It is possible that these differences indicate an incipient stage in the formation of a new species. It is also interesting to find another sisorid, viz., *Glyptothorax housei* Herre, endemic in the Anamalai Hills *G. housei* differs from the other South Indian species, such as *G. madraspatanus* (Day), *G. lonah* (Skyes), *G. annandalei* Hora and *G. trewasae* Hora, in possessing a smooth skin. In this feature it resembles *G. conirostre poonaensis* Hora, from which it is distinguished by the longer barbels, the size, the lesser height of the dorsal and its greater distance from the adipose fin, the size and position of the anal, the shorter head and the greater development of the adhesive organs.

Of considerable zoogeographical importance is the occurrence of a species of the genus *Homaloptera* in the Anamalai Hills. The genus *Homaloptera* is known from Eastern Burma, Siam, Malay Peninsula and the East. The presence of *Homaloptera montana* Herre in Peninsular India throws much light on the phylogeny of South Indian homalopterids and also helps in tracing the migratory highroads of these torrential fishes. A certain amount of speciation of *Homaloptera* took place in the Eastern Himalayas resulting in the genus *Balitora*. It is clear that *Homaloptera*, like the other torrential fishes, reached the Western Ghats along with the first influx along the Satpura trend of mountains which was evidently continuous with the Eastern Himalayas at that time. Having reached the Western Ghats these fishes migrated to the south, in the Peninsula.

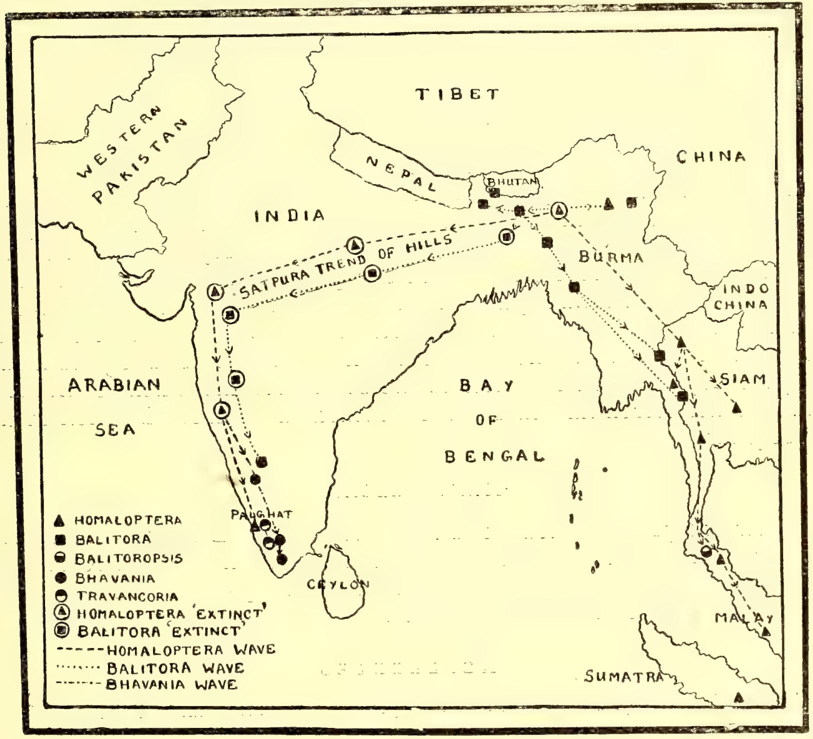

TIBET
CHINA
WESTERN PAKISTAN
NEPAL
BHUTAN
INDIA
SATPURA TREND OF HILLS
BURMA
INDO CHINA
SIAM
ARABIAN SEA
BAY OF BENGAL
PALGHAT
CEYLON
MALAY
SUMATRA
▲ HOMALOPTERA
■ BALITORA
● BALITOROPSIS
● BHAVANIA
● TRAVANCORIA
Ⓐ HOMALOPTERA 'EXTINCT'
◉ BALITORA 'EXTINCT'
------ HOMALOPTERA WAVE
········ BALITORA WAVE
-·-·-·- BHAVANIA WAVE

Fig. 2

Map showing the probable routes of the waves of migration of Homalopterid Fishes to peninsular India.

On reaching the Central Division of the Ghats, from *Homaloptera* was developed a better adapted and more evolved form as is seen in the present day genus *Bhavania*. *Homaloptera* and *Bhavania* continued the southward movement and reached the Southern Division prior to the formation of the Palghat Gap. It is now known for certain that the disruption of Ceylon from Peninsular India took place during the Pliocene and it is supposed that the formation of the Palghat Gap was later than this change. The homalopterids are absent in the mountain ranges of Ceylon. Having reached the Southern Division *Bhavania* migrated further south. The genus *Travancoria* is believed to have been a further attempt at speciation of the genus *Homaloptera* which was isolated in the Southern Division. *Homaloptera* and *Travancoria* are found in the Anamalai Hills and *Travancoria* is also found further south in Northern Travancore. *Bhavania* at present occurs both in the Central Division of the Ghats in Mysore and the Southern Division in Travancore.

No species of *Homaloptera* has so far been recorded from the Central and Northern divisions of the Western Ghats. In the east, *Homaloptera* migrated along the mountain ranges of Burma to Siam and Malay Peninsula. As it had given rise to *Bhavania* in Peninsular India, *Homaloptera* also gave rise to *Balitoropsis* in Siam.

Balitora from its original home in the mountain ranges of the Eastern Himalayas and Assam migrated along two similar lines in subsequent waves. *Balitora brucei mysorensis* found in Mysore and *Balitora brucei burmanicus* found in Burma are geographical races of *Balitora brucei* of Eastern Himalayas. *Balitora melansoma* of southern Burma is also closely related to *B. brucei*. *Balitora* is not found in the Southern Division of the Western Ghats and it is likely that the Palghat Gap acted as a barrier to the southward movement of *Balitora* and of other torrential fishes which reached the Central Division in the subsequent waves.

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II. *Glyptothorax* prox *madraspatanus* Day 1. Lateral view; 2. Dorsal view; 3. Ventral view.

FILIPEDIUM, A NEW GENUS OF GRAMINEAE (GRASSES)

BY

M. B. RAIZADA & S. K. JAIN

(*Forest Research Institute, Dehra Dun*)

(*With one plate*)

Filipedium Raizada et Jain *genus novum;* pertinet ad Gramineas, sect. Andropogonearum. Accedit ad *Capillipedium* Stapf, a quo tamen differt pedicellis spathulatis, ut plurimum spiculis pedicellatis atque spiculis sessilibus haud aristatis.

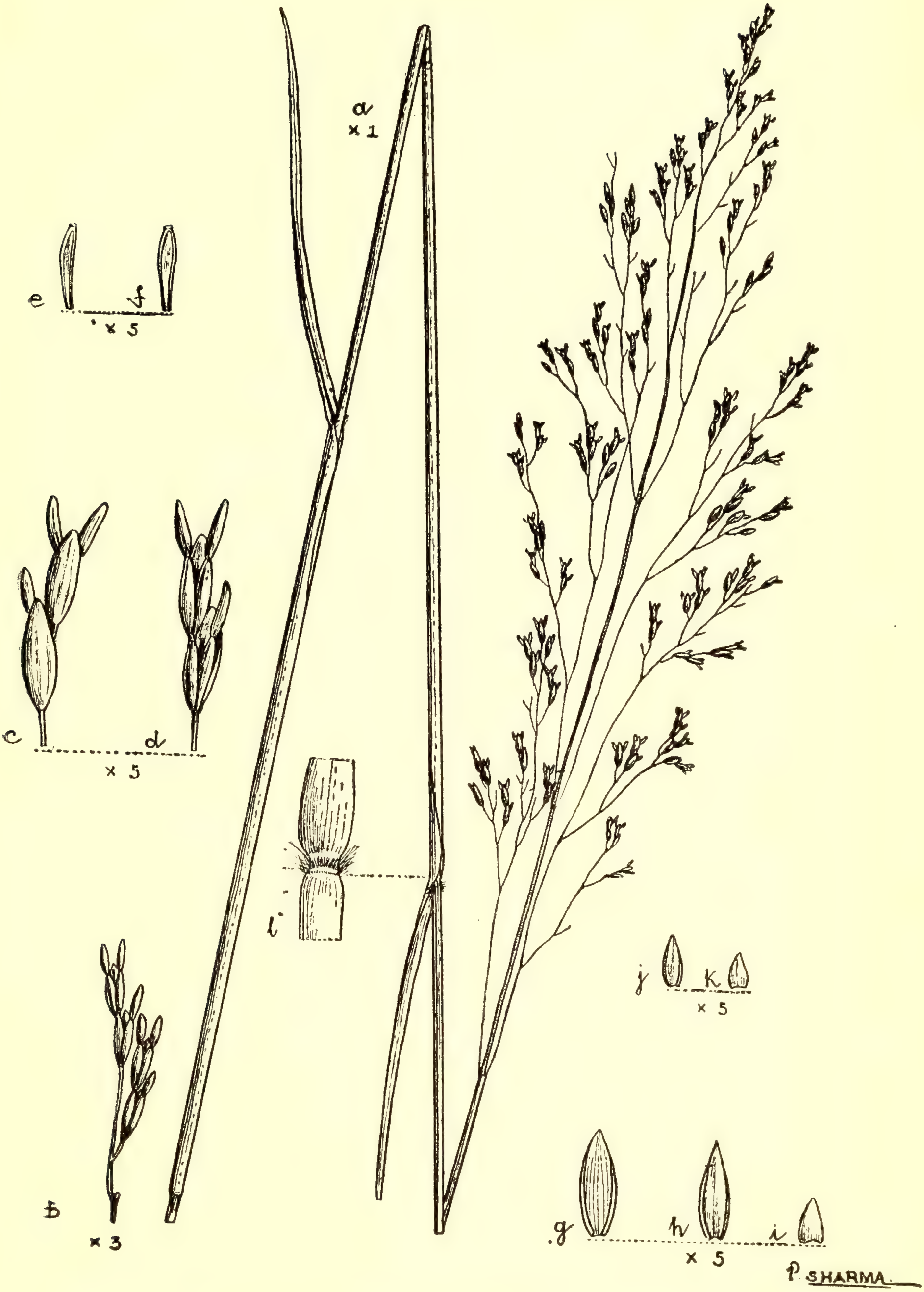
Spiculae binae, quarum una sessilis, altera vero pedicellata, distinctae inter se forma, magnitudine atque sexu, dispositae in racemos in apice ramorum capillarium in aperto paniculo; rami verticillati, nudi ad basim; racemorum nodi atque pedicelli fere similes, complanati, hyalini in medio; pedicelli conspicue spathulati. Spicula sessilis decidit cum nodo adjacenti atque pedicello spiculae pedicellatae spicula pedicellata decidit ex pedicello. Spicula sessilis dorso compressa, haud aristata. Glumae I atque II similes, plus minusve chartaceae, leves; gluma I subbicarinata, marginibus anguste incurvis; gluma II fortiter carinata; gluma III ut plurimum abest. Flosculus superior bisexualis; gluma IV ad squamam hyalinam reducta vel nulla. Stamina tria. Stigmata duo. Spicula pedicellata ut plurimum rudimentaria, ad 2 glumas vestigiales reducta; gluma II ut plurimum brevior quam gluma I; flosculi nulli.

Gramina perennia. Culmi graciles, ut plurimum erecti, simplices vel ramosi, nodis generatim glabris. Foliorum laminae lineares, apicibus elongatis.

Filipedium Raizada and Jain (Gramineae-Andropogoneae). This genus is closely related to *Capillipedium* Stapf from which it can be easily distinguished by the spathulate pedicels, usually rudimentary pedicelled spikelets and unawned sessile spikelets.

Spikelets 2-nate, one sessile the other pedicelled, differing in shape, size and sex, in few-jointed fragile racemes at the ends of the capillary branches of a loose panicle; branches whorled, naked at base; joints of the raceme and pedicels almost similar, flat, hyaline in middle, pedicels conspicuously spathulate. Sessile spikelet falling with the adjacent joint and the pedicel of the pedicelled spikelet; pedicelled spikelet falling from its pedicel. *Sessile spikelet* dorsally compressed, unawned. Glumes I and II equal, more or less chartaceous, smooth; glume I sub-2-keeled, margins narrowly incurved; glume II strongly keeled; glume III usually absent. Upper floret hermaphrodite; glume IV reduced to a hyaline scale or absent. Stamens 3. Stigmas 2. *Pedicelled spikelet* usually rudimentary, reduced to 2 vestigial glumes; glume II usually shorter than I; florets O.

Perennial grasses. Culms slender, usually erect, simple or branched, nodes usually glabrous. *Leaf-blades* linear, long-tapering.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P. SHARMA

Filipedium planipedicellatum (Bor) Raizada and Jain

Type species: *Filipedium planipedicellatum* (Bor) Raizada and Jain *comb. nov.* (based on *Capillipedium planipedicellatum* Bor). One species from India.

Filipedium planipedicellatum (Bor) Raizada and Jain *comb. nov.* *Capillipedium planipedicellatum* Bor in Kew Bull. (1949) 222.

Perennial. *Culms* more than a meter high, erect, simple, slender, smooth, purplish in colour, nodes glabrous. Leaf-sheath tight, terete or slightly compressed, smaller than the internodes, striate, smooth; ligule short, membranous, ciliate above. *Leaf-blades* linear, almost 8 cm. long, 3 mm. wide, acuminate, long-tapering to a fine point, margins scabrous, involute or flat, base rounded, bearded in throat. *Panicle* up to 20 cm. long, 7-8 cm. wide; branches whorled, loose; *racemes* naked at base, bearing short spikes in upper part, 6-7 cm. long; branches capillary flexuose, 2-jointed, smooth, glabrous. Racemes fragile, usually with 3 sessile spikelets, the lower two with one pedicelled spikelet, the terminal one with two pedicelled spikelets. Joints of the raceme and pedicels similar, smooth, glabrous, 1.5-2.5 mm. long, flat, hyaline in the middle, pedicels conspicuously oblanceolate, slightly thickened at the apex, purple, fragile. *Sessile spikelet* falling with the adjacent joint and the pedicel of the pedicelled spikelet. Pedicelled spikelet falling from its pedicel. Sessile spikelet 3 mm. long, elliptic-oblong, acute, dorsally compressed. Glume I 3 mm. long, 9-nerved, elliptic-oblong, acute, chartaceous, smooth, glabrous, purplish-brown, sub-2-keeled, margins narrowly incurved; glume II equal in length, strongly keeled at back, lanceolate, acute, 3-nerved, purple, smooth, margins narrowly inflexed. Lower floret O. Upper floret hermaphrodite, glume IV O or a narrow hyaline scale, palea broadly triangular, hyaline, 1.5 mm. long, 1 mm. wide. Lodicules 2, cuneate. Stamens 3. Styles 2; stigmas 2, plumose. Pedicelled spikelet: pedicel similar to the joint of the raceme but thickened at apex; spikelet much reduced to 2 vestigial glumes; glume I 1.5 mm. long, narrowly or broadly lanceolate, acute; glume II much shorter; florets O.

Manipur State, Palel, elevation 2,500 ft.; (Bor-17,059; 10th Nov. 1942). 'A grass 3-4 ft. tall—in swamps—spikelets purple'.

This grass was regarded by Dr. N. L. Bor to be a member of the genus *Capillipedium* Stapf. He found it to be different from all known species of the genus and described it as a new species, *Capillipedium planipedicellatum* Bor (Kew Bulletin 1949, 222). Bor, however, had pointed out that it was a remarkable grass differing from other species of the genus *Capillipedium* in several important features.

While engaged upon an exhaustive study of the Indian species of the genus *Capillipedium* Stapf the authors critically examined the type specimen of this grass (*C. planipedicellatum* Bor), which revealed that it markedly differed from all other members of the genus in the absence of awn, spathulate pedicels and rudimentary pedicelled spikelets. With such marked differences the inclusion of this grass in the genus *Capillipedium* is not only anomalous but contaminates the purity of this genus. The creation of a new genus *Filipedium* was, therefore, found necessary to accommodate this remarkable grass.

ACKNOWLEDGMENT

We are grateful to Rev. Father H. Santapau for very kindly putting the description of the genus into Latin.

EXPLANATION OF PLATE

(*a*) Upper part of the culm and inflorescence.
(*b*) A branch of panicle.
(*c*) and (*d*) Two opposite views of a raceme :
  (*c*) Rudimentary pedicelled spikelets in the background.
  (*d*) Conspicuous spathulate pedicels almost masking the sessile spikelet.
(*e*) A joint of raceme.
(*f*) Pedicel of the pedicelled spikelet.
(*g*), (*h*) and (*i*) Glume I, II and palea of the sessile spikelet.
(*j*) and (*k*) Glume I and II of the pedicelled spikelet.
(*l*) Leaf-base showing ligule.

THE GIR FOREST AND ITS LIONS

BY

K. S. Dharmakumarsinhji & M. A. Wynter-Blyth, M.A. (Cantab.), F.R.E.S.

Part III

Continued from p. 470 of this volume

1. The Lion in Bhavnagar (by K. S. D.)

Lions existed all over Kathiawar in ancient times and were still to be found in many parts of the peninsula until the middle of the 19th century. In Bhavnagar territory their main habitat was the Sihor Hills, and the adjacent Ramdhari Hills which run in a north-westerly direction to join the Chotila range, another old haunt of lions. The Ramdhari Hills were studded with low scrub forest, while at Sihor there is a thick well-wooded jungle of mixed thorny trees. These two ranges are of distinct character, and the lions were known as being of the Ramdhari or Sihori type, although there could have been no difference between the two.

Since then the lion has, of course, completely disappeared from these hills; I believe the last was killed at Sihor in the time of Thakore Jaswantsinhji, my great-grandfather. After this it was over 60 years before lions were again seen in the State and that was many miles away from the Sihor Hills, in a small portion of the Kundla district known as the Mytiala Hills, the name being derived from the old village of Mytiala ensconced amidst them. These hills are the eastern terminus of the Gir highland system and are divided from it by the river Dhantarwardi, which is also almost the demarcation line between Bhavnagar and Baroda States. The highest of these hills is between 500 and 1000 feet.

It was here in October 1917 that a lioness and two cubs were recorded as wandering into the territory from the Gir where lions were considered very rare then. These animals stayed but a short time.

Following this occurrence no more lions were recorded until 1920, when Mytiala had another visit, again in October, from a lion, two lionesses and two half-grown cubs. In 1922 two more lions were seen in these hills; after that date we began to have regular yearly visits but so keen were sportsmen to bag them that many of them were shot. At that time, I regret to state, preservation was not strict, nor was it so until the rule of my brother, H.H. the Maharajah Raol Shri Krishnakumarsinhji. This is seen from the records of attempts made to shoot these lions, mostly females, during the minority administration of the present ruler. Nevertheless it is to the credit of R. S. Krishnachandra Kalubha, the then Superintendent of Police who accompanied my father so often on shikar, that a fairly good record was kept.

As years went by, lions mostly females, continued to enter Mytiala but they never stayed in the territory for any length of time. These animals may well be termed migratory, for, since the forest was so poor in trees and lacking in water, there was no temptation for the animals to remain unless they had made a kill. It was fortunate that the distance of Mytiala from any large city was so great that by the time any rail or road bandobast could be made for a shikar camp the animals had had ample time to slip back into Baroda Gir territory. This used to happen quite often and still does to the present day, as the Mytiala area comprises only six square miles of territory, some of which is bare open hills.

As soon as the first male lions were recorded entering the territory in 1929, His Highness, with great foresight, made a rule preserving the females. Since then no lionesses have been shot. Having bagged such a rare animal, His Highness afforded ample opportunity to his close friends to shoot 'shootable' lions, as they were termed, meaning lions whose front pad measured $3\frac{3}{4}$ inches or over. It is of interest to note that some of the lions were shot on foot.

As time advanced, more and more lions entered the Preserve and it was at His Highness's suggestion that an afforestation scheme was begun. The arduous task of dispersal of seeds and watering young plants was entrusted to the Shikar Department. As there seemed to be some possibility of conserving water, three small lakes were also constructed. These proved to be successful in attaining their object except during the very hot months when they dried up. Nevertheless, this water encouraged the growth of vegetation and soon trees and undergrowth flourished. Now, owing to strict preservation and conservation of the forest, the Mytiala Hills form an ideal resort for lions. Moreover, the abundance of natural prey entices lions to stay for long periods, with the result that for the last four or five years it has been possible to find lions there throughout the year, something that would have been considered impossible when we began the scheme.

In the early '30's I could count the trees in each valley: today these valleys are a mass of forest vegetation, a delightful spectacle during the monsoon when foliage is green and thick.

His Highness possesses an old shooting hut placed on the side of a hill from which there is a magnificent view of the Mytiala Valley, called the 'Door', which is the main abode of the lions: a cart track winds through the jungle to pass Mytiala village. From this hut, which is placed, as it were above the corridor of the valley through which most of the lions enter our territory, one looks over the village of Khambha towards the summit of Nandi Velo, the highest peak to be seen in the area. Mamai Peak of the Mytiala range is close by, and from this the sea is visible beyond Rajula on a clear day.

The preservation of forest and game has given a distinctive character to this part of Bhavnagar territory. Whenever guests asked where our territory ended and that of others began, the invariable reply was that Bhavnagar territory was where trees and game could be seen—a fact that could not be denied.

* * *

The lion as I know him is a magnificent animal. The appearance of a full-maned lion is formidable and one that instils respect. He is by no means aggressive, but from my experience prefers seclusion and resents disturbance. For him the most important question is food, for not everywhere is there sufficient. Owing to heavy population surrounding his home in the Gir, he is disturbed as soon as he leaves the forest. But in spite of this, because he has learnt to know that man seldom has evil intentions towards him, he has become used to the presence of human habitations. The lion of Kathiawar, unlike some African lions, does not look on man as his enemy, except when he is hunted with the gun, and therefore one does not (nowadays) meet with man-eating lions. Moreover, decrepit lions and lionesses seem to die a natural death in solitude when their powers of hunting fail rather than attack man towards whom they have a natural fear.

Lions, then, are frequently found around human habitations and it is rarely that a family of lions does not call at a *nesda*[1] during the night. This, of course, is to seek for any cattle that have either lagged behind on their way home or have been poorly secured within the *nes*. Lions, consequently, feed frequently on domestic cattle and are therefore a constant menace. The lion when he preys upon cattle always has, it seems to me, a guilty feeling of theft, for he does not normally show fight if the owners try to drive him away. However, when very hungry, he gets irritated by human interference and displays defiance by roaring and demonstrating. But these attacks cannot be compared with the deliberate cold-blooded charge of a wounded lion. Nevertheless, I have known some cases of over-bold maldharis who have tried to drive a pair of lions from a kill at night, being badly mauled by one of them which was reluctant to part with his meal. Such cases of attack are rare, but when a maldhari has lost one of his most valued possessions he tends to become something of a lion himself !

As a rule a number of men coughing or talking is enough to drive a pride of lions off their kill. From my experience, if a lion has been deprived of his food immediately after killing, he will utter an angry roar and leave the area disgusted. I recollect the case of a heifer that had been killed by a pair of lions, whose carcass was removed in a lorry. When the lions found their meal had been stolen they roared furiously a number of times during the night, but left the jungle before day-break.

The lion of the Gir may be seen singly, in pairs, or in prides. The largest pride I have seen consisted of nine animals of which two were males ; but five or six of varying size with one male lion is not an unusual sight. Solitary males may be seen, but it seems a special characteristic of the Gir lion to move in pairs, generally both males, one usually slightly larger than the other. This unit is locally termed a *bélad*. I personally believe the two animals find hunting made much easier by their association, a fact I can corroborate from my personal experience. At Mytiala there was a full grown buffalo bull which was always left out in the open at night but was never attacked in the course of many years, and seemed well capable of defying any single lion, or lioness with cubs, until, one fateful night, a bold pair of lions hunting in concert brought him down.

The Gir lion appears to be less courageous than his African brother and is reluctant to attack a full-grown buffalo unaided. However, both single lions and lionesses have been known to bring down full-grown nilgai bulls, and I myself have the record of a lioness that killed a large bull at Mytiala one season.

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[1] Herdsmen's hamlet in the Gir.

Nilgai (*Boselaphus tragocamelus*) of course, form an important proportion of the game killed by lions for food. There was once a pair of lions living in the Mytiala Hills which regularly used to prey on nilgai with the result that these animals became very wary even during the daytime, keeping to the steep sides and higher ridges of the hills, and taking alarm at the slightest appearance or scent of us. Lions have even been known to bring down nilgai at mid-day during the cooler season, a time when these antelopes suspect little danger. At this time of day I once watched a herd of about fifty of them that was stopped dead by a pair of male lions, and then immediately turned and fled in the opposite direction. Fortunately for them the lions were not hungry. Another remarkable spectacle I had the good fortune to see was a nilgai bull following some lions that had been feeding on a kill. The lions made no attempt to attack the nilgai, although he was not fifty yards away, and he seemed aware that they meant him no harm.

Lions have also been known to kill panthers and we had such a case recently at Mytiala.

Well-fed lions are lazy and will allow close approach. It is during the heat of the day that one comes suddenly upon them whilst they are lying up, and it is then that they, being frightened themselves, show defiance. On such occasions it is best to shout and beat a discreet retreat! A lioness with cubs is still more to be feared, for even though she may be sleeping, the cubs, intrigued by the appearance of this strange new animal, come to investigate. The mother awakening, perhaps finds one of her family missing and comes in search of it, and then finds you whom she suspects of being the thief! On seeing young cubs it is advisable to make off as rapidly as is practicable without waking mother.

A lioness with cubs gives out a nerve-wracking continuous growl. I have watched cubs, with their mother growling thus and twitching her tail as she looked up at me. More than once I expected her to spring at me in my machan (which was not a high one) but fortunately she decided otherwise.

During a beat I have seen a lioness, deserted by the male which had moved silently away, growling fiercely in defence of her cubs and deliberately biting and pushing them to urge them out of danger. Finally she scattered them and moved on reluctantly. Yet on the other hand I have seen very clearly, in our own jungle, a pride of lionesses and cubs beaten past the machan at mid-day.

Shikaris know very well the danger of pressing lions too quickly and with too much noise, but if properly managed they give no trouble. Nevertheless, lions vary in temperament individually, and I have known some lions which have only been made to move after much roaring and growling. One lioness was particularly dangerous and created a great fuss whenever our shikaris came across her. She earned herself a name for this, and the shikaris were able to recognise her immediately by her unmitigating behaviour.

Lions, when driven, often give a roar when they get up, and then follow a trail silently, carefully watching the ground ahead of them, often pausing to listen. Males are inclined to amble or run if they are suddenly pressed, while females move more slowly. Lions which have had their companions shot in the Gir are very wary when they are driven. Their attitude then is to leave the covert as quickly as possible and to seek the protection of another.

Owing to persecution by maldharis when they have killed cattle, lions seldom return to such kills, and are wont to consume as much of them as they can that night. However, when they have killed away from *nesdas* in the jungle and are left undisturbed they invariably return to their kills, and I have seen them feeding on one for three consecutive nights. After a kill has been made under such conditions the lion keeps guard over it during the daytime to prevent vultures from feeding on it, often getting up with a growl or roar to rush towards the birds and drive them away. I have even seen a dead vulture near a lion's kill which may well have been killed by a blow from the lion.

After a lion has killed he usually begins to feed from the rear. When the kill has been made by a pride there is much growling and the male generally feeds first, though this is not always the case.

* * *

Unless they are very hungry lions hunt by night, and, being intelligent animals, they normally hunt up-wind.

Although I have never had the good fortune to see lions bring down wild game, evidence supports the theory that a pride on sighting game often breaks up and silently surrounds the quarry.

Two lions will separate in opposite directions as they catch sight of their prey moving towards them, or they may stalk it by a pincer movement. The last I saw clearly when two lions stalked a heifer which was tied up. The smaller of the two lions, approaching from the front, had come within twenty yards of the heifer when the latter espied him, but the heifer was not sure of what she had seen. The sight was magnificent. The lion was lying low in two feet of grass, peering at the heifer, with only the top of the head, eyes and tip of his nose visible. On becoming aware he had been seen, he froze and kept as still as a rock with his ears pressed down. Every time the heifer gazed in his direction he closed his eyes to a slit lest he betray himself; such is the intelligence of lions. When the heifer looked away, he opened them again and showed intense interest, as if to decide whether to attack or not, but he seemed diffident to do so until the bigger lion appeared from the side somewhat to the rear of the heifer. The heifer wheeling to face the larger lion, was the signal for the younger one to charge, which he did, an action the larger one immediately followed, one seizing the rear of the beast, the other fastening himself onto the throat. The fangs in the throat, one paw on the muzzle and the other on the back of the neck with the weight of the body behind it soon ended its life.

I have known a single well-maned lion thus kill a three-quarters grown heifer in no time: in an instant the animal was lying dead. The lion kills a goat mercilessly and as he seems to bite at any part of its body, I have seen these poor animals die lingering deaths. One extraordinary sight I once witnessed was the extraction of the entire skin of a goat in one movement by a lion, like a glove being removed from the hand. How this was performed I keep wondering to this day.

The lion is silent when hunting but he often emits a roar when close to a *nes*. This he does to cause panic among the beasts enclosed inside, and if an animal is so stricken as to break out through the *wado* or zareba he immediately pounces upon it. Lions wander a great deal during their night vigils and it is not unusual for them to cover fifteen or twenty miles. They have a definite predilection for moving along paths or cart tracks, and often return along the same route.

Lions roar after they have killed and a pride may join in the chorus. A lioness with cubs gives a low moaning roar to call her young, but otherwise she is more silent than the male. A lioness with young cubs emits a continuous low growling if apprehending danger, but if the cubs are half-grown she usually moves silently away with them following her.

A lioness meaning business looks at one in a menacing way, though without snarling, and may depress her ears, a sure sign of her determination to charge if further encroached upon. I well recollect an incident during a pig beat when two half-grown lion cubs passed us at a distance of only five yards, and a very large lioness, the mother, showed every inclination to charge, but finally changed her mind, when she saw her offspring bounding away safely in the distance.

While an unwounded lion is nothing to be feared, a wounded one is extremely dangerous and should never be approached without adequate precautions. Once a lion has been hit by a bullet he throws himself about, with low pitched roars, and it is at this critical time that fire should be accurate and in succession. Unless he has seen the marksman, he usually attempts to flee or keeps turning in all directions. A lion which is ready to charge gives a roar and raises his tail above his back, the mane also being raised.

* * *

The lion is a less cunning beast than the tiger, and hence is more easily disposed of by the various hunting methods.

Lion shooting from a machan is tame enough as the animal readily comes out into the open, often following a nullah or ravine if there is one close by, whereas on foot he affords good sport.

Though I have seen many lions being killed, only once have I heard a lion giving his death cry. This was a full grown male which, having been shot through the heart and shoulder, ran into a valley, gave two piercing, moaning roars, and immediately expired.

The usual procedure employed by us in hunting lions is as follows. First of all it is necessary to find the track of a 'shootable' lion which has entered the Reserve: a shootable lion being one with the pad of the forefoot 3¾″ in diameter, measured in dust or river sand where the ground is not so soft as to leave an exaggerated impression. The *puggies* or trackers soon locate the lion by following his spoor, and it is indeed remarkable how adept they are at following a track across hard dry soil or sometimes even over rock. As the trackers are well acquainted with the habits of lions and know the terrain, they can usually guess accurately where he is going to lie up, and having located the animal even go right up to him whilst he is lying down unaware or asleep.

Once the trackers are hot on the trail they will not give up. As the power of the sun increases they keep close on the heels of the lion knowing that he will soon lie up. Sometimes when following a trail in a valley it is necessary to send scouts, or *chadikars* as they are called, ahead onto the sides of the valley to spot the animal in front. During the hot weather lions lie up in favourite shady spots and in ravines or caves, and it is then that they are most easily located and approached. But during the monsoon and after it they are inclined to settle themselves on the sides and near or on the summits of hills. The grass then is tall and plentiful and there is much foliage on the trees, so that it is rather difficult to spot them at this time of the year. During the winter, as also during the monsoon, lions are likely to be continually on the move resting only for short intervals, and it is then that one has to depend on experienced trackers. But once the animal has been seen or marked down, a beat may either be arranged with the hunter in a machan, or a bait may be tied up in the evening, the latter being the safer method if the exact whereabouts of the lion is not known. If possible, it is a sound plan to allow a kill to be made before undertaking a beat, for a well-fed lion does not travel far and is easily tracked the next day so that a beat may be arranged with certainty. Even for the safety of a sportsman shooting off the ground, as has often been the case with us, it is better to fire at a well-fed lion rather than at one that is hungry. However, if it is decided to sit up, this is of course best done when the lion has not fed, when there is more chance of his making the kill.

* * *

Usually lions eat as much as they can at one sitting and do not always return to their kill the second night. But if they do they usually come late, whereas if they have not returned, then on the third night they are likely to come early to a fresh live bait, since they will be hungry.

Whether lions will return to a kill depends on several factors—the number of lions, the size of the kill, where and when the kill was made, and lastly on their previous experience. A return visit, as mentioned before is never made to kills near *nesses,* whereas a kill made in undisturbed forest in the early hours of the morning may even see a lion feeding during the day and keeping guard over it. On the other hand a kill made by a pride in the early evening will in all probability be entirely devoured that night.

When a lion is repeatedly fed in one locality he does not move far and is inclined to become fat and lazy, coming irregularly to the known kill and acting strangely.

For the hunter, then, the best method of bagging a lion (that is, if he has good trackers) is to arrange a beat after a kill has been made. For complete safety most sportsmen prefer to have a machan built, but if the lion is lying up in a valley it is a good plan to post oneself in an advantageous position well above where the quarry is expected to appear. If the site is well camouflaged, such places are safe enough, provided the shot is not taken head on. The lion seldom looks up and I have often been placed in open machans without being seen. Nevertheless it is better to be well camouflaged as any slight movement may be spotted.

The advantages of shooting at lions during the daytime are, of course, manifold—the target is clear and there is every chance of placing the first and subsequent shots, and, finally there is time, if necessary, for following up a wounded animal.

Sitting up in the evening is all very well if the lion comes to the kill or tie-up before dark, but personally I regard shooting from machans at night a mug's game, and one that gives every chance of a wounded lion. Still, if skilful trackers are not available and the sportsman is prepared to take a chance, this is a way open to him without much cost or trouble.

A goat is usually tied up together with the heifer to attract the king of beasts by his bleating. The disadvantage of this is that the lion invariably pulls away the goat in his first rush, and may only return to kill the heifer when he has disposed of the goat. The delay then is very trying. Moreover, in the case of one or more lions the hazard of the 'shootable' lion running away with the goat, or a lioness seizing the prey before the male, is considerable, and this hazard is increased during the winter months when the light fades quickly after sunset. Still it is a practice much adopted.

It is my experience that if lions do not come before about 10 p.m. near a *nes*, they are unlikely to come at all except in the early hours of the morning. Nevertheless, if lions are heard roaring in the neighbourhood it may be well worth the sportsman's while to sit up until midnight, for there is always a possibility of their appearing.

From what I have seen I agree with most observers that, when a lion and lioness are hunting in concert, it is the latter that attacks first. When a male lion approaches a kill in the open I have noticed that he creeps up stealthily; then, standing up and straightening himself, he stretches forward his shapely head and neck with the hair of the mane bristling, and charges. A male lion, if he is not hungry may play with the bait like a cat with a mouse, until the lioness comes up and kills it.

Lions wander a good deal during the monsoon, and it was at this season and just after it that they first returned to Mytiala. Because cover and water are then plentiful the animals move far from their natural abode, the Gir. Moreover, lions at this season prefer to keep to the hilltops and the valleys close to their summits during the daytime. This is, I believe, to escape from the flies and mosquitoes that infest the steamy valleys and low ground, and perhaps also the disturbance by grasscutters. Lions during the winter months also frequently settle in similar places for their day's rest, often without much shade. This is never the case during the hot weather when they lie up in shady ravines not far from water, and in caves and under trees, especially banyan (*Ficus*) trees and keramda (*Carissa carandas*) bushes. At that time of the year, too, lions do not wander far from their accustomed daytime abode, invariably returning to the same patch of jungle, unless hunger drives them further afield and forces them to rest in some unusual cover such as a large clump of euphorbias. When in such cover a lion will not usually leave it without causing trouble.

* * *

It has often been observed that a lion will keep with his mate for quite a long time after the birth of her cubs, only leaving her when the cubs are more than two or three months old. The cubs, which, in my experience, number two, three, or four, (occasionally five) remain with their mother for a year or more, and often until she is ready for her next litter. Two mothers with their cubs may join forces, and a third female has been known to join them. Such a group may be accompanied by an adult male or young males.

During the mating period, which may take place at any time of the year, lions roar frequently and the male and his spouse then go without food for a long time. Curiously enough kills which are made at such times are often left uneaten, and the lion seems to be easily irritated during his honeymoon.

The manes of lions vary considerably. They may be tawny, rufous-tawny, tawny and grey, black and tawny mixed with grey, black and gray or rarely even black. An interesting point is that the size of the lion seems to have little relation with the size of the mane. The colour of the coat also varies, some being tawny, others greyish-tawny with a blackish tinge. One skin sent to me by a friend is almost entirely blackish. Dark coated lionesses have also been seen.

Finally size: Rowland Ward gives 10 ft. 1 in. as the record length of an Indian lion shot by Lord Lamington in the Junagadh Fir. As much reliance cannot be placed on the above, probably Colonel Fenton's record of a 9 ft. 7 in. lion should be allowed to stand until some more reliable figures are produced to take its place.

APPENDIX

Records and Measurements[1] *of Lions shot in the Mytiala Lion Reserve*[2] *Forest, Bhavnagar State*

DATE		DETAILS
Oct.	1920	1 lioness shot by P. A. (Gohelwad) and Capt. Harris.
,,	1922	1 lioness shot by Col. Burke.
Aug.	1926	1 lioness shot by K. S. Vijayasinhji.
Sept.	1927	2 lionesses shot by H. H. Palitana. 2 lionesses shot by R. S. Krishnachandra.
Aug.	1929	2 lionesses shot by H. H. Bhavnagar.
Sept.	1930	1 lion shot by Col, Mosse. Length : 8′ 6″.
,,	1931	2 lions shot on foot by H. H. Bhavnagar. Length : 8′ 10″ and 8′ 5″.
Nov.	1932	1 lion wounded by R.N.B.
Sept.	1933	1 lion shot by R. S. Dharmakumarsinhji. Length : 8′ 6″. Shot on foot.
Jan.	1935	1 lion shot by R. S. Nirmalkumarsinhji. Length : 8′ 7″. Height : 39″.
Jan.	1938	1 lion shot by R. S. Dharmakumarsinhji. Length : 8′ 10½″. Height : 39″.
Dec.	1938	1 lion shot by H. H. Maharani Saheba of Bhavnagar. Length : 8′ 8¼″. Height : 37″. Girth : 48″. Tail : 37″. Front Pad : 3¾″.

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[1] All between pegs.

[2] Lions residing in the Mytiala Reserve after 1930 may certainly be considered as overflow from the Gir forests.

Date	Details
Jan. 1940	1 lion shot by Yuvraj Saheb of Wankaner and K. S. Chandrabhanusinhji of Wankaner. Length: 8′ 6″. Height : 38″. Front Pad : 3½″. Girth : 42″. Tail : 33″.
Feb. 1940	1 lion shot by Thakore Saheb of Wadhwan. Length : 8′ 6″. Height : 40″. Front Pad : 3 5/8th″.
Jan. 1941	1 lion shot by H. H. Bhavnagar. Length : 9′. Height : 40″. Girth : 45¾″. Tail : 37″. Front Pad : 3¾″.
May 1945	1 lion shot by H. H. Bhavnagar. Length : 8′ 3″. Height : 35″. Front Pad : 3½″. Shot for VE Day celebrations.
Apr. 1946	2 lions shot by H. H. Bhavnagar. 1st male : Length : 8′ 3″. Tail : 28½″. Front Pad : 3½″. 2nd male : . . . Length : 8′ 0½″. Tail : 36″. Front Pad : 3¼″ The latter was shot because he was lame and considered dangerous; the former to celebrate VJ Day. (There were 9 lions in the forest on this date, 7 of which were in the beat).

Some other Records

Dec. 1933	1 lion shot by R. S. Nirmalkumarsinhji at Andhania (Jetpur Gir). Length : 9′ 4″. Height : 38″. Girth : 60″.
„ 1933	1 lioness and two partially grown cubs (one male; one female) shot by R. N. B. at Andhania. Female : . . . Length : 8′ 4″. Male cub. . . . Length : 6′ 7″. Female cub : . . . Length : 6′ 5″.
Apr. 1934	1 lion shot by H. H. Bhavnagar at Sasan (Junagadh Gir). Length ; 8′ 7½″. Height : 39″. Front Pad : 3¼″. Hind Pad : 3½″.
1871	1 lion shot by Capt. Trother at Shane. Length : 8′ 10″. Tail : 35″. Height at shoulders : 40″. Girth 48″.
	Lions shot by Colonel Watson, P. A. (end of last century). Two lions : . . . Length : 9′ and 9′ 1″. One lioness : . . . Length : 8′ 6″.

SOME BIRD ASSOCIATIONS OF BENGAL

BY

M. D. LISTER

(*With a sketch map*)

I have tried in the following pages to set forth an accurate picture of the various major associations of birds as I found them during a period of nearly 17 months at Jessore, and 3 months at Dhubalia, both in Bengal. Both lie behind the Sundarbans, but Dhubalia, which is some six miles NNW of Krishnagar, lies some 60–70 miles WNW of Jessore and is relatively much drier with rather less luxuriant vegetation.

The Indian countryside, like any other, is made up of a mixture of an infinite number of different characters, and in a study of this kind it is possible to separate only the major types of habitat occurring in the survey area, disregarding the many minor variations which occur within each of the main types.

Thus, although the country, particularly round Jessore, is sprinkled liberally with small tanks, they do not usually appear to have a sufficiently marked avifauna of their own to warrant their separate consideration ; if indeed they have one, it is usually submerged in that of the dominant type of land in which the tank is situated. Only where there were special circumstances did I feel that a tank could justifiably be dealt with as a separate type of habitat.

In most cases I have disregarded geographical sub-species, as it is usually almost impossible to differentiate between them in the field without reference to good museum specimens, and these were not available.

JESSORE	DHUBALIA
Period of Survey : 14th April 1943 to 9th Sept. 1944, with 3 breaks of about a fortnight each and one of a month in Sept. 1943.	11th Sept. to 11th Dec. 1944 with one break from 10th to 31st Oct.
Co-ordinates : 23° 11′ N. 89° 10′ E.	23° 30′ N. 88° 28′ E.
Natural Vegetation Region : Tropical Rain Forest.	
Altitude : 20′ A.M.S.L.	45′ A.M.S.L.
Subsoil : Alluvium with a few pockets of brick earth.	Alluvium.
Habitat Types :	
I. CIVILISATION GROUP :	
(1) Country Town.	(1) ——
II. CULTIVATION GROUP :	
(2) Mixed cultivation.	(2) Mixed cultivation.
(3) Paddyfields.	(3) Paddyfields.

III. JUNGLE GROUP:

(4) Mixed jungle.	(4) Mixed jungle.
(5) Scattered roadside trees (dominantly peepal).	(5) ——
(6) ——	(6) Mango grove.
(7) Small groves of palms.	(7) ——

IV. WASTE LAND GROUP:

(8) Waste land under grass (including aerodrome).	(8) Waste land under grass (including aerodrome).
(9) ——	(9) Semi-marsh land.
(10) Marsh.	(10) ——

V. INLAND WATER GROUP:

(11) Small river.	(11) Small river.
(12) Jheels and tanks.	(12) Jheels.

DESCRIPTION OF HABITAT TYPES:

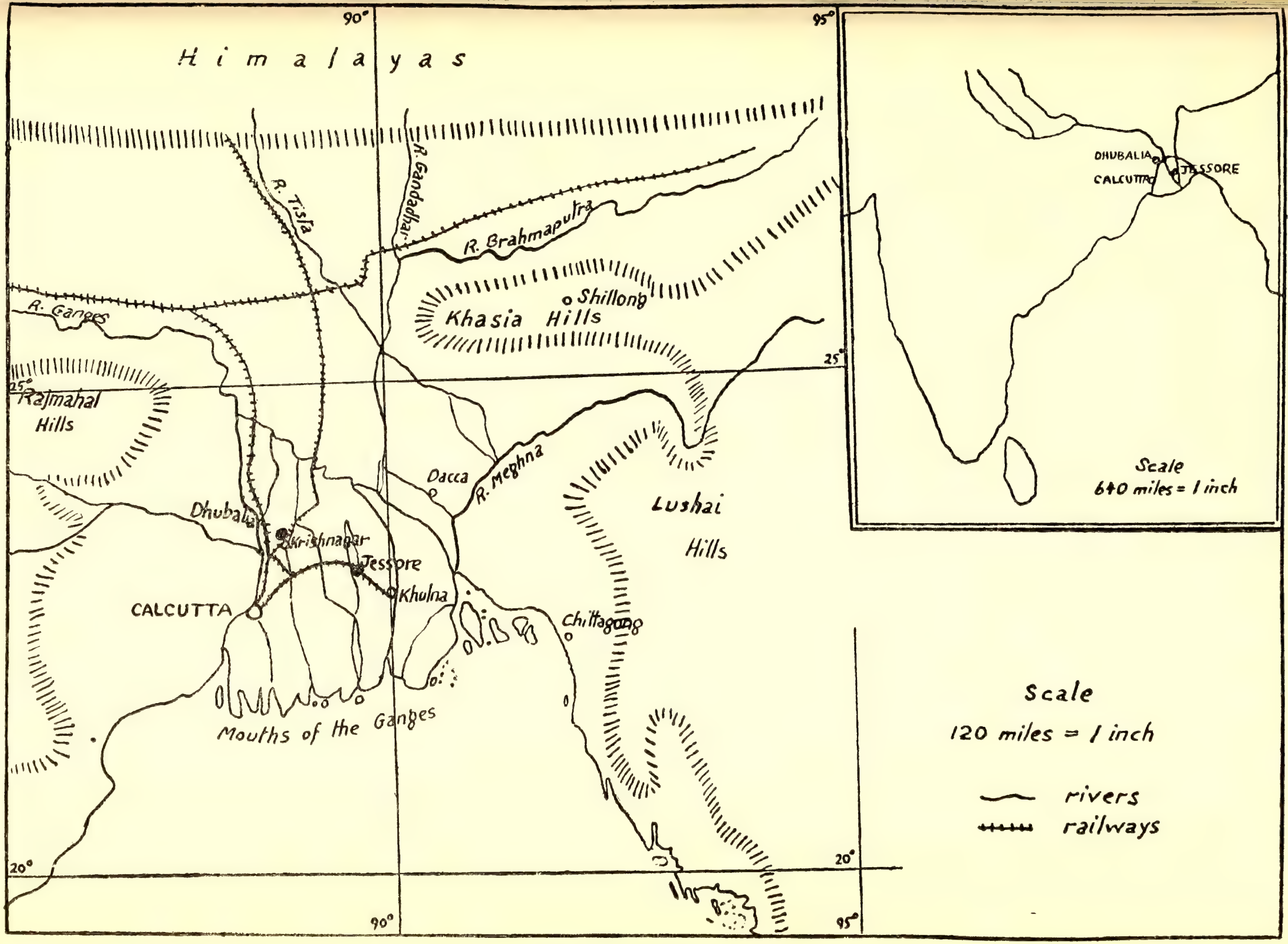
I. CIVILISATION GROUP

JESSORE

(1) *Country Town* : Jessore is a typical small Indian provincial town, spreading out more and more thinly the further it extends from the congested core of the Bazar. Outside the Bazar area the roads are fairly open and lined with large mature trees (many banyans). Buildings are widely spaced and the rest of the ground is occupied by compounds, tanks (see Introduction) and open patches of more or less waste land. The whole area is very well wooded, with large mature trees, predominantly banyan, tamarind, a species of cedar or deodar (?), and various palms (mostly coconuts), with a sprinkling of flowering trees in the compounds. Most of the larger buildings have plenty of open work about them (verandahs, balconies, porches, etc.) which attract such species as House Swift, House Sparrow and Common Myna for nesting

DHUBALIA

The built-up area here consisted principally of Service hutments, camps and aerodrome buildings, all fairly well dispersed so that they merged into the habitat type in which they were situated, and could not be satisfactorily separated from it.


90°
95°
Himalayas
R. Tista
R. Gandadhar
R. Brahmaputra
R. Ganges
Shillong
Khasia Hills
25°
Rajmahal Hills
Dacca
R. Meghna
Lushai Hills
Dhubalia
Krishnagar
Jessore
Khulna
CALCUTTA
Chittagong
Mouths of the Ganges
20°
DHUBALIA
CALCUTTA
JESSORE
Scale
640 miles = 1 inch
Scale
120 miles = 1 inch
rivers
railways

LOCATION OF SURVEY AREA

JESSORE	DHUBALIA
purposes. In addition to the permanent buildings, a large number of 'basha' huts had been built to house Service personnel. My living quarters and mess were in this area and for a short time I also worked there both by day and by night.	

II. CULTIVATION GROUP

JESSORE	DHUBALIA
(2) *Mixed Cultivation*: The 'fields' are open spaces of various shapes and sizes, set in a matrix of fairly dense mixed jungle with a fair amount of undergrowth. The two are so closely interwoven that it is impossible to treat them as separate habitat types, though on an acreage basis the cultivated ground would, I think, predominate. Mostly low-growing root and surface crops, not identified. Visited only occasionally on foot, but each visit usually lasted several hours.	(2) *Mixed Cultivation*: This area is more open than at Jessore, the fields being well broken up by rough hedges and small patches of mixed jungle. It includes several fairly large blocks of rough grassland (similar to park land) studded thinly with trees (chiefly mango) which are not satisfactorily separable. Visited very frequently on foot.
(3) *Paddyfields*: The chief product of the district is rice and the paddyfields may be described as the matrix in which all other types of habitat are set. Whereever there is any flat land comparatively free from trees it is covered with paddyfields, separated by the usual low bunds, which in the rainy season are flooded to a depth of 12–18″. In addition to the paddy there was a fair amount of jute and a few small patches of other low-growing root and surface crops. The whole of this paddy land is sprinkled with small groves of palm trees, with little or no undergrowth, and in many cases the paddy grows right under the trees.	(3) *Paddyfields*: Rice is not grown here to quite such an extent as at Jessore. There were only 1–2 small tracts of paddy land, which, during the survey period, was still flooded and very damp, with the paddy about 18″ high. *Note*.—The flooding of such great areas must no doubt have some effect on the bird population and is a subject which would probably repay further study. My records are not sufficiently detailed, however, to warrant dealing separately with the paddy land during the periods when it was dry and in flood. In actual fact I saw comparatively little change in the bird population which could definitely be attributed to the flooding, but I was told on fairly good authority that further out in the country more water birds and waders were in evidence in the fields.

III. JUNGLE GROUP

JESSORE

(4) *Mixed Jungle*: Fairly extensive and patchily dense. Dominant trees mango and bamboo, but various palms, red silk cotton, jack-fruit, lichi and many other kinds also present. Undergrowth varied and at edges of forest gave place to large bushes and scattered babool trees. Several fairly large tanks among the trees, but these were not treated as a separate habitat type. I spent much time here, both by day and by night.

In this type I have also included patches of roadside jungle, which were usually observed only in passing and were not explored. These varied in size and composition, the dominant trees usually being banyans, bamboos and various palms (especially coconuts).

(5) *Scattered roadside trees and bushes*: These formed a narrow ribbon of irregular growth on either side of sections of the road embankment, usually where it ran through paddyfields. The dominant trees were peepal, with a smaller proportion of babool, banyan, palmyra palms and mango. Usually observed only when passing in a vehicle.

(7) *Groves of Palms*: Principally Coconut Palms (*Cocos nucifera*), Date Palm (*Phoenix sylvestris*) and Palmyra Palm (*Borassus flabelliformis*) and Betel-nut Palm (*Areca catechu*), but identity of some trees uncertain. Whole district, especially the paddyfields, sprinkled with

DHUBALIA

(4) *Mixed Jungle*: The whole countryside is broken up by rough untidy 'hedges' and small patches of mixed jungle, consisting of large straggling bushes, usually growing in a dense tangle, with trees of various kinds. Some of the hedges are swollen into considerable belts of dense bushes. Undergrowth varies. Dominant trees difficult to determine, but tamarind, mango and various palms (including some palmyras) probably predominate.

(6) *Mango Grove*: This covered 1½–2 acres. Trees all mature and large, spaced 25–40 ft. apart, the canopy being almost continuous. No undergrowth, except at edges; inside the grove the earth was bare even of grass. This grove contained a number of large 'busti' huts, in one of which I lived.

JESSORE	DHUBALIA
small groves of palms, sometimes mixed, sometimes almost entirely Coconut or Date or Betel-nut. Usually no undergrowth and paddy often growing under the trees. Much toddy-tapping done, and this no doubt attracted insects, which in turn attracted birds (*see* General Observations).	

IV. WASTE LAND GROUP

(8) *Waste land under grass*: Fairly extensive and included much of a large aerodrome and the land surrounding it. Intersected by several roads and small dykes and ditches. Covered with rough grass which in the rainy season was up to 3′ tall over considerable stretches. This area was sprinkled with small groves of palms and an occasional small scrubby bush. A fair number of well-dispersed 'busti' buildings. Herds of several hundred oxen often grazed here. Aircraft constantly taking off and landing. My visits to this type were usually in a jeep or truck and were less frequent than to some of the other habitat types.	(8) *Waste land under grass*: This covered about 4 sq. miles and included a large aerodrome. Consisted simply of rough grass, with occasional small isolated bushes. A fair number of well-dispersed 'busti' buildings and at least one small Indian village, but these were not satisfactorily separable from the main type. Some cattle grazing. Large numbers of coolies working on the aerodrome, and aircraft constantly taking off and landing.
	(9) *Semi-marshland*: 800–1,000 acres adjoining river and jheels. In the rainy season, (which had ended just before the survey period began) it is obviously very damp and flooded in most places. A good deal of water (up to 2–3″) still about at first, but by the end of the survey period this area had taken on more of the character of rough waste land. Whole area covered with a fairly dense growth of marsh grass, in flower during period. Small bushes of briar and bramble type here and there and small babool trees. Clearly only seasonal marshland. Whole area under observation on foot fairly frequently, usually for several hours at a time.
(10) *Marshy waste land.* Covered many acres. Full extent not explored and observation confined to several hundred yards of perimeter. It consisted of very damp ground covered with deep, grassy herbage up to 4′ in height in rainy season. After monsoon this was largely beaten down to form a platform over the water (at least 2′ deep), strong enough to carry most birds. Ample cover for birds in the herbage.	

V. INLAND WATER GROUP

JESSORE

(11) *Small river*: 25-30 yds. wide. Very sluggish indeed and in most places much overgrown with weeds [predominantly Water Chestnut (*Trapa bispinosa*) or water hyacinth ?] During rainy season there is a good deal more water, but this quickly disappears and thereafter much of the vegetation rots down. The weeds provide excellent cover for birds. Under irregular observation along several short stretches of the bank.

(12) *Jheels and tanks*: In this group I have included an open jheel lying among paddy fields, the only cover at its edge being paddy; and a tank some 70 × 70 yds. also lying among paddyfields and much overgrown. The artificial banks of this were high and were studded with a few trees and bushes. Both were large enough to have a recognisable bird population of their own. The jheel also was largely overgrown with weeds. Both were visited only occasionally.

DHUBALIA

(11) *Small river*: 25-30 yds. wide. Moderately slow current. Margined irregularly with scattered clumps of marsh grass growing on and broken here and there by short stretches of mud bank. At one end of the stretch under observation was a small fishing weir. Observed irregularly over a length of about two miles.

(12) *Jheels*: At one point the river broadens out into a wide jheel adjoining the semi-marsh land. 3-400 yds. away is another jheel connected to the first by a small, swiftly-flowing seasonal stream running through soft marsh. The 2nd jheel was more than 500 yds. long and 30–40 yds. wide bordered by dense marsh grass (some 3–5 ft. high in places) and weeds. Watering places for cattle at intervals. The 1st jheel dried out almost completely before the end of the survey period, but although the water level in the 2nd jheel fell, I believe, judging from air photos, that it does not normally dry out completely. Visited frequently on foot.

Animals: *Domestic*: Bullocks, cattle, water buffalo and goats predominated and wandered about everywhere. The bullocks and water buffalo were the main draught animals in the district, with a few horses. There were also large numbers of pie-dogs and a few cats.

Wild: Jackals (*Canis aureus*): Very numerous.

Indian Fox (*Vulpes bengalensis*): Numerous throughout the district.

Hyaena (*Hyaena striata*): A few believed to be in the district, but this was not proved.

Common Grey Mongoose (*Herpestes mungo pallidus*): numerous. Often mobbed by birds, especially Common Myna and Magpie Robin.

Common Striped Squirrel or Tree Rat (*Sciurus palmarum*): Numerous. Often mobbed, especially by Common Mynas and Magpie Robins.

Leopard (*Felis pardus*): One or two occasionally reported.

Fishing Cat (*Felis viverrina*) or possibly Common Jungle Cat (*Felis chaus*): seen at night on several occasions.

Flying Foxes (*Pteropus edwardsii medius*): From June to December these were numerous, especially about the large mango trees in Type (1) at Jessore.

Common Langur [*Presbytes* (*Semnopithecus*) *entellus*]: A small party was often to be seen at Dhubalia, but did not occur at Jessore.

Reptiles: Water Monitor (*Varanus salvator*): One reported twice at Dhubalia on good authority, but not seen by me. Snakes plentiful, of various kinds, including cobra.

Amphibians: Frogs very numerous, especially at Jessore. Species not identified.

Insects: The insects were so numerous and varied as to be a perfect pest, particularly at night and during the rainy season, and especially at Jessore.

General:

(1) *Conditions*: Bird-watching depended on the opportunities afforded by intensive war work, but on the whole these were numerous and covered every part of the day and night. Apart from casual observations at all times, most of my spare time was spent in bird-watching, usually alone. For identification purposes I was confined to the usual books (including the *Fauna of British India*—Birds, 2nd Edition), as there was no museum available for specimens.

(2) *Preponderance of Observation*: I. Jessore: I lived and had my meals in Type (1), and for the first few months of the survey period I also worked there. Later I worked in Type (4) being conveyed there by car or truck through Types (3), (5), (1) and sometimes (8). I often spent the day and the night in Type (4) both in the dry and (though to a lesser extent) in the rainy season.

II. Dhubalia: I lived in Type (6) and worked in Type (8) but had frequent opportunities of exploring on foot all the other habitat types covered.

(3) *Disturbance*: The population of the whole district, both at Jessore and Dhubalia was increased by several thousand Service personnel, and in addition to the native traffic on the roads there was continual Service traffic as well. In addition, aircraft were constantly flying low overhead and landing at and taking off from the aerodromes. I saw little evidence, however, that these caused any real disturbance among the birds, though the soaring species (Vultures, Kites, etc.) were sometimes scared away.

Migration: I did not obtain enough positive evidence to be of any real use in determining migratory trends. Wherever necessary I have given dates in the lists given below.

Birds and Red Silk Cotton Trees (*Bombax malabaricum*): This tree grows fairly abundantly over the whole survey area, especially at Jessore, both on its own and among other kinds of trees. It flowers during the dry season, before its leaves appear. The large waxy flowers are very popular with many species of birds, which would perch close to one of the flowers and plunge their heads into the trumpet. Whether their object was to drink the dew, which collects in considerable quantities in the bottom of those flowers which happen to be growing vertically, or to find some form of food (? insects or nectar) inside the blossom, I have been unable to ascertain, but I incline to the former in view of the diversity of the species seen there.

The species I have seen at these flowers are as follows:

Jungle Babbler (*Turdoides somervillei*), Red-vented Bulbul (*Pycnonotus cafer*), Red-whiskered Bulbul (*Pycnonotus jocosus*), Magpie Robin (*Copsychus saularis*), Common Myna (*Acridotheres tristis*), Jungle Myna (*Æthiopsar fuscus*), Pied Myna (*Sturnopastor contra*), Green Barbet (*Megalaima zeylonicus*).

Birds and Toddy Palms: It is the practice in these districts as in many others, to tap the palm trees for toddy. A horizontal cleft is made in the trunk just below the branches; from this a short, narrow vertical slit is made into which is inserted a small piece of split bamboo, which acts as a gutter to carry off the liquid away from the trunk. An earthenware bowl or chatti is suspended so that the gutter leads into is mouth. It is a frequent, though not invariable, practice to tie or wedge a small bunch of grass over the gutter, no doubt to keep insects away from the liquid. A cloud of flies can usually be seen hovering over the outlet, whether the grass is there or not.

The flies, no doubt, attracted some species of birds, but so did the liquid itself. The bamboo gutter formed a most convenient perch and the birds made full use of it, taking the liquid as it flowed down the chute. I have seen several species do this, and on one occasion I saw a Tickell's Flowerpecker fluttering a few inches below a gutter to which no bowl was attached, and catching the drops of liquid as they fell. In all, I have seen the following species at the liquid:

Jungle Crow
Jungle Babbler
Red-vented Bulbul
Red-whiskered Bulbul
Black Drongo
Tailor Bird
Common Myna
Jungle Myna
Pied Myna
Grey-headed Myna
Tickell's Flowerpecker
* Golden-backed Woodpecker.
* Mahratta Woodpecker.

Birds and Cattle: For this purpose I include in the term 'cattle' water buffalo, oxen, cows and goats, though the majority of the instances I have witnessed concern oxen. Oxen are used extensively in these districts for ploughing, transport, etc., and may be seen anywhere along the roads and in the fields. Herds of several hundred beasts used to be grazed on the grassy waste land at Jessore [Type (8)], and to a lesser extent on the same type at Dhubalia. There were not very many water-buffalo in the district, though herds were often driven through Jessore, bound, I believe, for the Calcutta market. Goats were very numerous wherever there were native dwellings. Almost anywhere where there are cattle, some birds may be seen foraging about them, the species varying to a certain extent with the place the cattle happen to be. At one time or another I have seen the following species so engaged.

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* These species were not seen to drink the liquid, and were probably after the insects attracted by the exposure of the sweet liquid.

Jungle and House Crows: These are usually to be seen associated with resting cattle in the streets of the villages or town. They cluster round the beasts and not only pick about on the ground among them, but also habitually perch on their backs and pick insects out of their eyes, ears and hide. It was no uncommon sight to see half a dozen House Crows and one or two Jungle Crows foraging about oxen lying down in the road outside my bungalow.

Common and Pied Mynas act in a similar way, but are to be seen about moving cattle as frequently as about resting ones. They often perch on their backs, whether the beasts happen to be working or not, though I do not remember ever having seen them do this when the cattle were pulling carts. But they are more often to be seen exploring the ground round the feet of the moving beasts in the fields, in an exactly similar way to Starlings (*Sturnus vulgaris*) in Europe.

Black Drongos almost invariably perch on the backs of moving or standing cattle, from which they make foraging sorties after flying insects. They also, rather less frequently, I think, catch insects on the beasts themselves.

The Magpie Robin's association, I think, is usually more fortuitous than deliberate, and occurs much less frequently. I have never seen one do more than fly down to the ground at the feet of cattle from a neighbouring perch.

White (and no doubt other) Wagtails may occasionally be seen foraging about moving or resting cattle, but I think the association is less marked than is often the case with the wagtails in Europe. This impression, however, may be partly due to the fact that most wagtails appear to be present in this district only for a comparatively short time each year, and that I have not been specially on the look-out for instances of their association with cattle.

The House Sparrow's association usually seems to be confined to occasional cases of foraging among beasts resting in the streets of the village or town.

Cattle Egrets (or Tick Birds, as they are popularly known) feed about browsing or ploughing, etc., cattle in much the same way as the Mynas, and they frequently pick insects off the beasts' legs and flanks.

I have never seen Red or Yellow-wattled Lapwings or gulls foraging among cattle, in the same way as Lapwings (*Vanellus vanellus*) or Black-headed Gulls (*Larus ridibundus*) do in Europe. Commensalism is a subject which could profitably be given much more attention in India than it has hitherto enjoyed.

Weather: In winter (Oct. to mid or end of March) the weather is usually very settled, with pleasantly warm days and quite cold nights, the difference between the day and night temperatures being particularly marked in December, January and February, though there is no frost. By the end of March, or a little earlier, the colder weather is beginning to break and there is more cloud, with storms and sudden squalls with winds up to about 50 m.p.h., and the humidity increases. These unsettled conditions continue until the South-west Monsoon has really arrived, and from then until the end of September the sky is more often than not filled with towering cumulus and cumulo-nimbus clouds, with some periods of stratus or strato-cumulus forming a cloud blanket over the whole area. There are many electric storms at this period and the humidity is very high. The real rainy season is June–September, when over 30″ falls. I give below some temperature and rainfall data.

	Temperature (Fahrenheit)				*Rainfall.*
Jessore:	*Average*		*Absolute*		
	Max.	*Min.*	*Max.*	*Min.*	
April 1943	91·3	71·4	99·0	64·0	5·18″
May ,,	94·9	76·7	98·0	71·0	2·25″
June ,,	No records available.				
July ,,	84·4	76·7	93·0	73·0	16·16″
Aug. ,,	88·8	77·4	92·0	75·0	13·62″
Sept. ,,	90·2	77·6	98·0	74·0	4.91″
Oct. ,,	91·0	73·5	96·0	66·0	6·39″
Nov. ,,	86·1	60·0	91·0	54·0	...
Dec. ,,	79·7	55·5	82.0	49·0	...
Jan. 1944	73·4	53·4	83·7	44·9	5·8″
Feb. ,,	79·2	56·9	88·2	52·5	1·0″
March ,,	84·0	64·0	94·0	56·4	3·47″
April ,,	92·6	73·1	98·0	62·0	4·46″
May ,,	97·9	79·4	107·0	71·0	3·04″
June ,,	90·5	77·9	101·0	71·0	4·55″
July ,,	88·5	78·6	93·0	75·0	13·49″
Aug. ,,	88·3	78·4	93·0	75·0	13·29″
Sept. ,, 1st–5th	88·8	77·6	90·0	74·0	(1·64″)
Dhubalia:					
Sept. ,, 18–30th	90·0	77·7	95·0	75·6	2·57″
Oct. ,,	88·0	72·3	92·0	75·0	0.96″
Nov. ,,	84·2	55·8	96·0	53·0	...
Dec. ,,	No records available.				

Method of Recording: Having spent the first few weeks after my arrival in exploring the district, ascertaining what major habitat types were involved and how they could best be grouped, I then made a list, with a separate column for each of the major habitat types covered. Another column contained a list of the species I had seen in the neighbourhood, with a 'X' in the habitat column to indicate in what types of habitat they had been seen. At irregular, though fairly frequent intervals, I went through this list and brought it up to date by the addition of new species seen, fresh habitats where they occurred and the addition of further columns for any new type of habitat not included previously. In doing this I relied on memory, coupled with my general bird records, and I believe the record to be complete. Six times during the period at Jessore and twice at Dhubalia this composite list was fair-copied into my general note-books, with full introductory notes on all appropriate 'background' matters such as agricultural operations, preponderance of observation and so on. A more accurate method would undoubtedly be to have kept detailed day-to-day records of all birds seen in each of the habitat types under observation, but this was impracticable here, though I have done the same thing over a period of some five years on a farm in England.

INCIDENCE OF SPECIES

I. CIVILISATION GROUP

(1) *Country Town*—Jessore

No.

1. Jungle Crow (*Corvus macrorhynchos*)[1]: Numerous, but rather less so than House Crow. Could often be seen foraging about the various Service cook-houses.
2. House Crow (*Corvus splendens*): As last, but rather more numerous. Often to be seen foraging outside the Indian eating houses in the Bazar proper, as well as about Service cook-houses, etc.
3. Indian Tree Pie (*Dendrocitta vagabunda*): Regularly seen and fairly plentiful.
4. Indian Grey Tit (*Parus major*): Fairly plentiful.
5. Jungle Babbler (*Turdoides somervillei*): Fairly plentiful.
6. Abbott's Babbler (*Malacocincla sepiaria*): 1–2 believed seen April 1944, but identity not proved beyond all doubt.
7. Common Iora (*Ægithina tiphia*): Plentiful.
8. Bengal Red-vented Bulbul (*Pycnonotus cafer*): Plentiful. Their numbers seemed to be increased towards end of rainy season.
9. Red-whiskered Bulbul (*Pycnonotus jocosus*): Plentiful, though rather less so than last species.
10. Magpie Robin (*Copsychus saularis*): Abundant.
11. Red-breasted Flycatcher (*Muscicapa parva*): Evidently only a winter visitor, as they were thinly distributed throughout this area from early December to early April.
12. White-browed Fantail Flycatcher (*Rhipidura aureola*): Rather thinly distributed.
13. Ashy Swallow-Shrike (*Artamus fuscus*): A few present in rainy season.
14. Indian Black Drongo (*Dicrurus macrocercus*): Abundant.
15. Indian Tailor Bird (*Orthotomus sutorius*): Fairly plentiful.
16. Indian Oriole (*Oriolus o. kundoo*): A few seen occasionally.
17. Black-headed Oriole (*Oriolus xanthornus*): Fairly plentiful. A nest with young found in July 1943.
18. Grey-headed Myna (*Sturnia malabarica*): Rather thinly distributed.
19. Common Myna (*Acridotheres tristis*): Abundant.
20. Pied Myna (*Sturnopastor contra*): Not quite so plentiful as No. 19.
21. Indian House Sparrow (*Passer domesticus*): Fairly plentiful.

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[1] The scientific names will appear only on the first mention of a species in the following lists.

(1) *Country Town*—Jessore (*Contd.*)

No.

22. Purple Sunbird (*Cinnyris asiatica*): Fairly plentiful.
23. Purple-rumped Sunbird (*C. zeylonica*): Fairly numerous—I think slightly more so than No. 22.
24. Tickell's Flowerpecker (*Dicaeum erythrorhynchos*): Somewhat thinly distributed, but no doubt often overlooked.
25. Golden-backed Woodpecker (*Brachypternus benghalensis*): Plentiful.
26. Tickell's Golden-backed Woodpecker (*Chrysocolaptes guttacristatus*): Rather less numerous than No. 25.
27. Little Scaly-bellied Green Woodpecker (*Picus xanthopygaeus*): As many as three seen together, but not plentiful.
28. Mahratta Woodpecker (*Dryobates mahrattensis*): A few seen.
29. Green Barbet (*Megalaima zeylonicus*): Plentiful.
30. Blue-throated Barbet (*Megalaima asiatica*): Plentiful.
31. Coppersmith (*Megalaima haemacephala*): Fairly plentiful, but less so than Nos. 31 and 32. On 12-8-1944 at least 50 were together in a row of large banyan trees; later a dozen or so flew to the concrete parapet of a small house, where they appeared to be taking something from the surface. Whether this was food in the form of insects or seeds, or small grains of sand or concrete for roughage, I could not tell.
32. Indian Cuckoo (*Cuculus micropterus*): Appeared to be abundant, though I could not judge to what extent it is locally migratory. From March to August its call was wearisome, but it was completely silent during the rest of the year.
33. Common Hawk Cuckoo (*Hierococcyx varius*): Abundant.
34. Pied Crested Cuckoo: (*Clamator jacobinus*): A few present in July and August, but not seen or heard at other times.
35. Koel (*Eudynamis scolopaceus*): Abundant.
36. Crow-Pheasant (*Centropus sinensis*): Plentiful. On one occasion I found one bird moving easily among the upper branches of a tree some 40′ above the ground.
37. Large Parrakeet (*Psittacula eupatria*): Not very plentiful.
38. Roller (*Coracias benghalensis*): A few, but not very numerous.
39. Green Bee-eater (*Merops orientalis*): Numerous.
40. Pied Kingfisher *Ceryle rudis*): A few seen about the tanks.
41. Common Indian Kingfisher (*Alcedo atthis*): Plentiful about the numerous tanks.
42. Stork-billed Kingfisher (*Ramphalcyon capensis*): Fairly plentiful.
43. White-breasted Kingfisher (*Halcyon smyrnensis*): Plentiful about the tanks.
44. House Swift (*Micropus affinis*): Fairly plentiful.
45. Palm Swift (*Cypsiurus batassiensis*): Fairly plentiful, though less so than outside the town.
46. Horsfield's Nightjar (*Caprimulgus macrourus*): Always 1–2 to be heard at night.
47. Collared Scops Owlet (*Otus bakkamoena*): 1-2 believed always to be heard at night, but not seen and voice was the only means of identification.

(1) *Country Town*—Jessore—(*Contd.*)

No.

48. Spotted Owlet (*Athene brama*): 1 identified in Aug. 1944.
49. Jungle Owlet (*Glaucidium radiatum*): 1–2 believed heard now and again, but identity not proved.
50. King Vulture (*Torgos calvus*): plentiful.
51. Long-billed Vulture (*Gyps indicus*): less plentiful than the other vultures.
52. White-backed Vulture (*Pseudogyps bengalensis*): Abundant.
53. Crested Serpent Eagle (*Spilornis cheela*): usually 1–2 about.
54. Pariah Kite (*Milvus migrans*): Ubiquitous.
55. Brahminy Kite (*Haliastur indus*): Plentiful.
56. Shikra (*Astur badius*): one seen once over the town.
57. Rufous Turtle Dove (*Streptopelia orientalis*): a few about.
58. Spotted Dove (*Streptopelia chinensis*): fairly plentiful.
59. Red Turtle Dove (*Oenopopelia tranquebarica*): a few about.
60. Blue Rock Pigeon (*Columba livia*): Fairly plentiful.
61. Cattle Egret (*Bubulcus ibis*): Fairly plentiful.
62. Indian Pond Heron (*Ardeola grayi*): fairly plentiful.

II. CULTIVATION GROUP

No.	SPECIES	MIXED CULTIVATION		PADDYFIELDS	
		JESSORE	DHUBALIA	JESSORE	DHUBALIA
1	Jungle Crow	plentiful.	fairly numerous.	plentiful foraging.	fairly numerous.
2	House Crow	plentiful, but less so than No. 1.	do., but less so than No. 1.	do., but fewer than No. 1.	......
3	Indian Tree Pie	fairly plentiful in and near jungle patches.	... ..	......	......
4	Indian Grey Tit	do.	......	......	......
5	Jungle Babbler	do.	numerous.	occasionally foraging.	......
6	Common Babbler (*Argya caudata*).	1 party believed seen on 26–12–43 but not positively identified.	fairly numerous.	......	......
7	Abbott's Babbler	1-2 believed seen April–May 1944.	......	......	......
8	Common Iora	plentiful.	......	......	......
9	Red-vented Bulbul	plentiful, foraging.	plentiful foraging.	plentiful foraging.	plentiful foraging.
10	Red-whiskered Bulbul	do., but rather less so than No. 9.	......	do., but rather less so than No. 9.	......
11	Magpie Robin	abundant.	plentiful foraging.	abundant foraging.	plentiful foraging.
12	Red-breasted Flycatcher	thinly distributed in winter months	......	......	......
13	Black-naped Flycatcher (*Hypothymis azurea*).	usually a few in jungle patches.	......	......	.. ...
14	White-browed Fantail Flycatcher	rather thinly distributed.	......	......	......
15	Bay-backed Shrike (*Lanius vittatus*)	......	......	not uncommon.	.. ...
16	Black-headed Shrike (*L. nasutus*)	......	......	a few.	......
17	Rufous-backed Shrike (*L. erythronotus*).	not uncommon.	......	not uncommon	......
18	Brown Shrike (*L. cristatus*)	a single one seen on 26–12–43.	fairly plentiful tho' less so towards end of survey period.	......	... .

19	Common Wood-Shrike (*Tephrodornis pondiceriana*).	a few.	......	......	......
20	Little Minivet (*Pericrocotus peregrinus*).	not uncommon.	......	......	......
21	Ashy Swallow-Shrike	......	one party seen.	......	......
22	Indian Black Drongo	abundant.	abundant.	abundant.	abundant.
23	Indian White-bellied Drongo (*Dicrurus caerulescens*).	......	a single bird seen on 18-11-44.	......	......
24	Blyth's Reed Warbler (*Acrocephalus dumetorum*).	1-2 believed seen, but identity not proved.	......	......	......
25	Indian Tailor Bird	fairly plentiful about jungle.	......	......	......
26	Burmese Tailor Bird (?) ...	on several occasions birds seen were a good deal darker and brighter than other birds. ? this sub-species.	......	......	......
27	Black-headed Oriole	fairly plentiful, chiefly in and near jungle patches	......	......	......
28	Grey-headed Myna	rather thinly distributed, chiefly about jungle patches.	a few foraging.	......	......
29	Common Myna	abundant.	adundant foraging.	abundant foraging.	a few foraging.
30	Bank Myna (*Acridotheres ginginianus*).	a few.	......	......	......
31	Jungle Myna (*Æthiopsar fuscus*) ...	rather thinly distributed.	......	......	......
32	Pied Myna	abundant; usually rather more than No. 28 in this type.	abundant foraging, usually rather more than No. 28 in this type.	abundant foraging, usually rather more than No. 28 in this type.	abundant foraging, usually rather more than No. 28 in this type.
33	Baya Weaver Bird (*Ploceus philippinus*).	......	numerous; always at least one flock in evidence, foraging.	one colony found nesting in a large tree among paddy fields.	......
34	White-throated Munia (*Uroloncha malabarica*).	......	......	usually a few to be seen.	......

II. Cultivation Group

No.	SPECIES	MIXED CULTIVATION		PADDYFIELDS	
		JESSORE	DHUBALIA	JESSORE	DHUBALIA
1	Jungle Crow	plentiful.	fairly numerous.	plentiful foraging.	fairly numerous.
2	House Crow	plentiful, but less so than No. 1.	do., but less so than No. 1.	do., but fewer than No. 1.	......
3	Indian Tree Pie	fairly plentiful in and near jungle patches.	... ..	......	......
4	Indian Grey Tit	do.	......	......	. ....
5	Jungle Babbler	do.	numerous.	occasionally foraging.	......
6	Common Babbler (*Argya caudata*).	1 party believed seen on 26-12-43 but not positively identified.	fairly numerous.	......	......
7	Abbott's Babbler	1-2 believed seen April–May 1944.	......	......	......
8	Common Iora	plentiful.	......	......	......
9	Red-vented Bulbul	plentiful, foraging.	plentiful foraging.	plentiful foraging.	plentiful foraging.
10	Red-whiskered Bulbul	do., but rather less so than No. 9.	......	do., but rather less so than No. 9.	......
11	Magpie Robin	abundant.	plentiful foraging.	abundant foraging.	plentiful foraging.
12	Red-breasted Flycatcher ...	thinly distributed in winter months	.. ...	......	......
13	Black-naped Flycatcher (*Hypothymis azurea*).	usually a few in jungle patches.	......	......	.. ...
14	White-browed Fantail Flycatcher ...	rather thinly distributed.	.. ...	......	......
15	Bay-backed Shrike (*Lanius vittatus*)	......	.....	not uncommon.	.. ...
16	Black-headed Shrike (*L. nasutus*)...	......	......	a few.	......
17	Rufous-backed Shrike (*L. erythronotus*).	not uncommon.	......	not uncommon	......
18	Brown Shrike (*L. cristatus*) ...	a single one seen on 26-12-43.	fairly plentiful tho' less so towards end of survey period.	......	... .
19	Common Wood-Shrike (*Tephrodornis pondiceriana*).	a few.			
20	Little Minivet (*Pericrocotus peregrinus*).	not uncommon.	......		...
21	Ashy Swallow-Shrike	......	one party seen.	..	.. .
22	Indian Black Drongo	abundant.	abundant.	abundant.	abundant.
23	Indian White-bellied Drongo (*Dicrurus caerulescens*).	......	a single bird seen on 18-11-44.	...	... --
24	Blyth's Reed Warbler (*Acrocephalus dumetorum*).	1-2 believed seen, but identity not proved.	......	......	......
25	Indian Tailor Bird	fairly plentiful about jungle.	......	.. ...	......
26	Burmese Tailor Bird (?) ...	on several occasions birds seen were a good deal darker and brighter than other birds. ? this sub-species.	......	.....	......
27	Black-headed Oriole	fairly plentiful, chiefly in and near jungle patches	......	......	......
28	Grey-headed Myna	rather thinly distributed, chiefly about jungle patches.	a few foraging.	.....	.. ..
29	Common Myna	abundant.	adundant foraging.	abundant foraging.	a few foraging.
30	Bank Myna (*Acridotheres ginginianus*).	a few.	......	......	......
31	Jungle Myna (*Æthiopsar fuscus*) ...	rather thinly distributed.	......	......	.. ...
32	Pied Myna	abundant; usually rather more than No. 28 in this type.	abundant foraging, usually rather more than No. 28 in this type.	abundant foraging, usually rather more than No. 28 in this type.	abundant foraging, usually rather more than No. 28 in this type.
33	Baya Weaver Bird (*Ploceus philippinus*).	......	numerous; always at least one flock in evidence, foraging.	one colony found nesting in a large tree among paddy fields.	......
34	White-throated Munia (*Uroloncha malabarica*).	......	......	usually a few to be seen.	.. ..

II. CULTIVATION GROUP (*Contd.*)

No.	SPECIES	MIXED CULTIVATION		PADDYFIELDS	
		JESSORE	DHUBALIA	JESSORE	DEUBALIA
35	Spotted Munia (*Uroloncha punctulata*).	a pair found nesting in a Tad palm in Aug. 1944.	......	......	......
36	Indian House Sparrow (*Passer domesticus*).	fairly plentiful about the threshing floors in the fields.	......	fairly plentiful about the threshing floors in the fields.	......
37	Indian Cliff Swallow (*Hirundo fluvicola*).	......	usually a few foraging	......	......
38	White-faced Wagtail (*Motacilla leucopsis*.	......	a few seen.	......	......
39	Yellow-headed Wagtail (*M. citreola*)	several seen about small jheels and tanks in winter.	......	......	......
40	Indian Pipit (*Anthus rufulus*) ...	......	abundant at first, but less numerous towards end of survey period.	Not uncommon about the drier parts.	......
41	Bengal Bush Lark (*Mirafra assamica*).	......	always a few about.	......	......
	Purple Sunbird (*Cinnyris asiatica*)...	fairly numerous about jungle patches.	......	......	......
43	Purple-rumped Sunbird (*C. zeylonica*).	do.; slightly more numerous than 42.	......	......	......
44	Tickell's Flowerpecker	usually a few about more wooded parts.	......	......	......
45	Golden-backed Woodpecker ...	plentiful wherever there were trees.	......	......	....

46	Mahratta Woodpecker	not uncommon.	......	......	......
47	Black-naped Green Woodpecker (*Picus canus*).	a black-naped woodpecker (I believe of this species) seen on 23-12-1943.	......	......	......
48	Fulvous-breasted Pied Woodpecker (*Dryobates macei*).	1 believed seen on 26-12-1943.	......	......	......
49	Green Barbet	plentiful wherever there were trees.	......	......	......
50	Blue-throated Barbet	do.; perhaps slightly less numerous than No. 49.	......	......	......
51	Coppersmith	fairly plentiful wherever there were trees.	......	......	......
52	Little Cuckoo (*Cuculus poliocephalus*).	twice believed seen in Dec. '43 and Feb. '44, but not identified beyond all doubt.	......	......	......
53	Indian Cuckoo	appeared to be abundant; called continuously March–August.	......	......	......
54	Common Hawk Cuckoo ...	abundant wherever there were trees.	......	......	......
55	Indian Plaintive Cuckoo (*Cacomantis merulinus*).	......	1 seen 2–3 times about hedges.	......	......
56	Koel	abundant in more wooded parts.	......	......	......
57	Crow Pheasant	plentiful in more wooded parts.	a few foraging.	......	......
58	Large Burmese Parrakeet ...	not very plentiful; and ? subspecies.	......	......	......
59	Roller	fairly plentiful.	not very plentiful.	fairly plentiful.	not very plentiful.
60	Green Bee-eater	abundant.	abundant · often perched on weeds or even a clod of earth.	abundant.	abundant.
61	Blue-tailed Bee-eater (*Merops superciliosus*).	......	......	reported, but not seen by me.	a few, usually in small parties.

II. CULTIVATION GROUP (*Contd.*)

No.	SPECIES	MIXED CULTIVATION		PADDYFIELDS	
		JESSORE	DHUBALIA	JESSORE	DEUBALIA
35	Spotted Munia (*Uroloncha punctulata*).	a pair found nesting in a Tad palm in Aug. 1944.	......	......	......
36	Indian House Sparrow (*Passer domesticus*).	fairly plentiful about the threshing floors in the fields.	......	fairly plentiful about the threshing floors in the fields.	......
37	Indian Cliff Swallow (*Hirundo fluvicola*).	......	usually a few foraging	......	......
38	White-faced Wagtail (*Motacilla leucopsis*.	......	a few seen.	......	......
39	Yellow-headed Wagtail (*M. citreola*)	several seen about small jheels and tanks in winter.	......	......	......
40	Indian Pipit (*Anthus rufulus*) ...	......	abundant at first, but less numerous towards end of survey period.	Not uncommon about the drier parts.	......
41	Bengal Bush Lark (*Mirafra assamica*).	......	always a few about.	......	......
	Purple Sunbird (*Cinnyris asiatica*)...	fairly numerous about jungle patches.	......	......	......
43	Purple-rumped Sunbird (*C. zeylonica*).	do.; slightly more numerous than 42.	......	......	......
44	Tickell's Flowerpecker	usually a few about more wooded parts.	......	......	......
45	Golden-backed Woodpecker ..	plentiful wherever there were trees.	......	......	....
46	Mahratta Woodpecker	not uncommon.	......	......	......
47	Black-naped Green Woodpecker (*Picus canus*).	a black-naped woodpecker (I believe of this species) seen on 23-12-1943.	......	......	......
48	Fulvous-breasted Pied Woodpecker (*Dryobates macei*).	1 believed seen on 26-12-1943.	......	......	......
49	Green Barbet	plentiful wherever there were trees.	......	......	......
50	Blue-throated Barbet	do.; perhaps slightly less numerous than No. 49.	......	......	......
51	Coppersmith	fairly plentiful wherever there were trees.	......	......	......
52	Little Cuckoo (*Cuculus poliocephalus*).	twice believed seen in Dec. '43 and Feb. '44, but not identified beyond all doubt.	......	......	......
53	Indian Cuckoo	appeared to be abundant; called continuously March–August.	......	......	......
54	Common Hawk Cuckoo ...	abundant wherever there were trees.	......	......	......
55	Indian Plaintive Cuckoo (*Cacomantis merulinus*).	......	1 seen 2–3 times about hedges.	......	......
56	Koel	abundant in more wooded parts.	......	......	......
57	Crow Pheasant	plentiful in more wooded parts.	a few foraging.	......	......
58	Large Burmese Parrakeet ...	not very plentiful; and ? subspecies.	......	......	......
59	Roller	fairly plentiful.	not very plentiful.	fairly plentiful.	not very plentiful.
60	Green Bee-eater	abundant.	abundant: often perched on weeds or even a clod of earth.	abundant.	abundant.
61	Blue-tailed Bee-eater (*Merops superciliosus*).	......	......	reported, but not seen by me.	a few, usually in small parties.

II. CULTIVATION GROUP—(*Contd.*)

No.	SPECIES	MIXED CULTIVATION		PADDYFIELDS	
		JESSORE	DHUBALIA	JESSORE	DHUBALIA
62	Pied Kingfisher	......	......	a few seen foraging over flooded paddy fields.	......
63	Common Indian Kingfisher	a few seen.	......	......	......
64	Stork-billed Kingfisher	fairly plentiful.	......	......	......
65	White-breasted Kingfisher	plentiful about jheels and tanks.	usually a few about, often perched in trees in the fields.	......	usually a few.
66	Hoopoe (*Upupa epops*)	1 seen on 2-2-1944.	a few.	......	......
67	House Swift	fairly plentiful, foraging	......	fairly plentiful, foraging.	......
68	Palm Swift	do.	usually a few to be seen.	do.	usually a few to be seen.
69	King Vulture	abundant	abundant.	abundant.	abundant.
70	White-backed Vulture	abundant	abundant.	abundant.	abundant.
71	Small White Scavenger Vulture (*Neophron percnopterus*).	......	one seen once.	......	......
72	Crested Serpent Eagle	usually a few to be seen.	......	......	......
73	White-eyed Buzzard Eagle (*Butastur teesa*).	......	......	1 seen 16-3-1944 perched on a telegraph wire.	......
74	Brahminy Kite	plentiful.	often a few about.	fairly plentiful.	......
75	Pariah Kite	ubiquitous.	ubiquitous.	ubiquitous.	ubiquitous.
76	Pale Harrier (*Circus macrourus*)	......	one believed seen soaring on 7-12-'44.	......	......
77	Shikra	......	a few.	......	......
78	Blue Rock Pigeon	fairly plentiful.	a few.	fairly plentiful.	......
79	Rufous Turtle Dove	do. wherever there was cover.	fairly numerous.	do. foraging.	......

80	Spotted Dove	do.	abundant.	do.	......
81	Red Turtle Dove	do.	fairly plentiful.	do.	......
82	Indian Ring Dove (*Streptopelia decaocto*).	not uncommon.	fairly plentiful.	do.	......
83	Grey Partridge (*Francolinus pondicerianus*).	not plentiful.	a few always about, but not very plentiful.	......	......
84	Common Bustard Quail (*Turnix suscitator*).	......	a few seen at close quarters.	......	......
85	Indian Button Quail (*Turnix maculatus*).	......	3 seen together on 22-9-44. One shot.	......	......
86	White-breasted Waterhen (*Amaurornis phoenicura*).	......	1–2 could always be found foraging in the evenings and at night.	......	1–2 could always be found foraging in the evenings and at night.
87	Bronze-winged Jacana (*Metopidius indicus*).	fairly plentiful about the jheels.	......	1–2 found in flooded paddyfields.	......
88	Pheasant-tailed Jacana (*Hydrophasianus chirurgus*).	......	......	do.	......
89	Painted Snipe (*Rostratula benghalensis*).	......	......	not uncommon in flooded paddyfields during the rains.	......
90	Indian Stone Curlew (*Burhinus oedicnemus*).	......	1–2 could be heard calling any moonlit night—identity believed correct, but not proved beyond all possible doubt.	......	......
91	Green Sandpiper (*Tringa ochropus*).	......	......	a few found in flooded paddyfields.	......
92	Common Snipe (*Capella gallinago*).	......	......	1 shot in flooded paddyfields.	......
93	Red-wattled Lapwing (*Lobivanellus indicus*).	fairly plentiful.	fairly plentiful. Usually noisy at night, especially about full moon.	fairly plentiful.	......

II. CULTIVATION GROUP—(*Contd.*)

No.	SPECIES	MIXED CULTIVATION		PADDYFIELDS	
		JESSORE	DHUBALIA	JESSORE	DHUBALIA
62	Pied Kingfisher	......	... .	a few seen foraging over flooded paddy fields.	......
63	Common Indian Kingfisher ...	a few seen.	.....	. .. ..	.. ..
64	Stork-billed Kingfisher . .	fairly plentiful.	.. ...	. .. -	.. ...
65	White-breasted Kingfisher ..	plentiful about jheels and tanks.	usually a few about, often perched in trees in the fields.	..	usually a few.
66	Hoopoe (*Upupa epops*)	1 seen on 2-2-1944.	a few.	.. ..	......
67	House Swift	fairly plentiful, foraging	.....	fairly plentiful, foraging.	.....
68	Palm Swift	do.	usually a few to be seen	do.	usually a few to be seen.
69	King Vulture	abundant	abundant.	abundant.	abundant.
70	White-backed Vulture	abundant	abundant.	abundant.	abundant.
71	Small White Scavenger Vulture (*Neophron percnopterus*).	... ..	one seen once.	......	.....
72	Crested Serpent Eagle	usually a few to be seen.	.....	......	......
73	White-eyed Buzzard Eagle (*Butastur teesa*).	......	......	1 seen 16-3-1944 perched on a telegraph wire.	......
74	Brahminy Kite	plentiful.	often a few about.	fairly plentiful.	......
75	Pariah Kite	ubiquitous.	ubiquitous.	ubiquitous.	ubiquitous.
76	Pale Harrier (*Circus macrourus*) ...	......	one believed seen soaring on 7-12-'44.	.. .	... ..
77	Shikra	......	a few.	......	......
78	Blue Rock Pigeon	fairly plentiful.	a few.	fairly plentiful.	......
79	Rufous Turtle Dove	do. wherever there was cover.	fairly numerous.	do. foraging.	......
80	Spotted Dove	do.	abundant.	do.	..
81	Red Turtle Dove	do.	fairly plentiful.	do.	. ..
82	Indian Ring Dove (*Streptopelia decaocto*).	not uncommon.	fairly plentiful.	do.	.....
83	Grey Partridge (*Francolinus pondicerianus*).	not plentiful.	a few always about, but not very plentiful.	... ..	......
84	Common Bustard Quail (*Turnix suscitator*).	.. ...	a few seen at close quarters.	... ..	.. ...
85	Indian Button Quail (*Turnix maculatus*).	......	3 seen together on 22-9-44. One shot.	......	......
86	White-breasted Waterhen (*Amaurornis phoenicura*).	......	1-2 could always be found foraging in the evenings and at night.	.. ...	1-2 could always be found foraging in the evenings and at night.
87	Bronze-winged Jacana (*Metopidius indicus*).	fairly plentiful about the jheels.	......	1-2 found in flooded paddyfields.	......
88	Pheasant-tailed Jacana (*Hydrophasianus chirurgus*).	. ...	......	do.	......
89	Painted Snipe (*Rostratula benghalensis*).	......	......	not uncommon in flooded paddyfields during the rains.	......
90	Indian Stone Curlew (*Burhinus oedicnemus*).	... ..	1-2 could be heard calling any moonlit night—identity believed correct, but not proved beyond all possible doubt.	......	. ...
91	Green Sandpiper (*Tringa ochropus*).	.....	......	a few found in flooded paddyfields.	.. ...
92	Common Snipe (*Capella gallinago*).	......	......	1 shot in flooded paddyfields.	......
93	Red-wattled Lapwing (*Lobivanellus indicus*).	fairly plentiful.	fairly plentiful. Usually noisy at night, especially about full moon.	fairly plentiful.	......

II. CULTIVATION GROUP—(*Contd.*)

No.	SPECIES	MIXED CULTIVATION		PADDYFIELDS	
		JESSORE	DHUBALIA	JESSORE	DHUBALIA
94	Little Cormorant (*Phalacrocorax niger*).	2 seen once on small pond.	......	......	seen several times on trees among paddyfields.
95	White-necked Stork (*Dissoura episcopa*).	......	......	Reported from flooded paddyfields but not seen by me.	......
96	Little Egret (*Egretta garzetta*) ...	......	......	do.	......
97	Cattle Egret ...	fairly plentiful.	always a few about.	fairly plentiful.	usually a few about.
98	Indian Pond Heron ...	do.	do.	do.	do.
99	Cotton Teal (*Nettapus coromandelianus*).	......	......	not uncommon among flooded paddyfields during the rains.	......
100	Lesser Whistling Teal (*Dendrocygna javanica*).	......	......	do.	......
101	Indian Little Grebe (*Podiceps ruficollis*).	......	......	1-2 seen among flooded paddyfields.	......
		Note.—It must be borne in mind that there was much more jungle among the mixed cultivation at Jessore than at Dhubalia, and than among the paddyfields.			

III. JUNGLE GROUP

No.	SPECIES	MIXED JUNGLE		ROADSIDE TREES	GROVES OF PALMS	MANGO GROVE
		JESSORE	DHUBALIA	JESSORE	JESSORE	DHUBALIA
1	Jungle Crow ...	numerous.	numerous.	always a few.	always a few.	plentiful.
2	House Crow ...	plentiful, though less so than No. 1.	fairly plentiful.	usually a few.	usually a few.	always a few.
3	Indian Tree Pie ...	fairly plentiful.	fairly plentiful.	occasionally present.	......	usually 1-2 about.
4	Indian Grey Tit ...	do.	not very numerous.	......	......	......
5	Jungle Babbler ...	do.	fairly plentiful.	not uncommon.	......	one party always about.
6	Common Babbler ...	......	do.	......	......	......
7	Red-capped Babbler (*Timalia pileata*).	......	usually a few about in thick bushes.	......	......	......
8	Abbott's Babbler ...	1-2 believed seen in April/May 1944.	......	......	......	......
9	Common Iora ...	plentiful.	fairly plentiful.	not uncommon.	......	not uncommon.
10	Jerdon's Chloropsis (*Chloropsis jerdoni*).	......	... ..	......	......	at least 2 appeared on 30-11-44 & were seen on several days.
11	Red-vented Bulbul ...	plentiful.	plentiful.	plentiful.	plentiful.	always a few.
12	Red-whiskered Bulbul ...	ditto, but less so than No. 11.	fairly plentiful.	fairly plentiful.	fairly plentiful.	sometimes 1-2.
13	Magpie Robin ...	abundant.	abundant, but I think not quite so numerous as at Jessore.	numerous.	numerous.	always several.
14	Orange-headed Ground Thrush (*Geokichla citrina*).	a single bird seen in spring 1944.	a single bird seen on 30-11-44.	......	......	......

III. JUNGLE GROUP—(*Contd.*)

No.	SPECIES	MIXED	JUNGLE	ROADSIDE TREES	GROVES OF PALMS	MANGO GROVE
		JESSORE	DHUBALIA	JESSORE	JESSORE	DHUBALIA
15	Red-breasted Flycatcher ...	evidently a winter visitor, thinly distributed.	numerous.	......	1–2 seen Oct. 43—Jan. 44.	after 1–10–44. always 1–2 about.
16	Verditer Flycatcher (*Eumyias thalassina*).	a single bird seen on 24–2–1944.	......	......	......	......
17	Paradise Flycatcher (*Tchitrea paradisi*).	rather thinly distributed during cold season; not seen at other times.	......	......	......	1, possibly 2 seen mid–Oct.
18	Black-naped Flycatcher ...	usually a few to be seen.	......	......	......	1 seen definitely once; presence often suspected.
19	White-browed Fantail Flycatcher.	rather thinly distributed.	a few about.	......	......	usually 1 about.
20	Bay-backed Shrike ..	......	......	a few.	a few.	......
21	Black-headed Shrike ...	......	......	......	a few in winter.	......
22	Rufous-backed Shrike ...	......	......	a few.	a few.	......
23	Brown Shrike ...	......	very numerous at first, less so towards end of survey period.	......	......	......
24	Common Wood-Shrike ...	not uncommon	not uncommon.	a few.	......	not uncommon.
25	Little Minivet ...	not uncommon.	......	......	......	not uncommon.
26	Ashy Swallow-Shrike ..	usually a few about.	a few seen.	......	......	......
27	Black Drongo ...	abundant.	plentiful.	fairly numerous.	fairly numerous.	always a few.

28	White-bellied Drongo ...	a small party believed seen 17-2-44.	......	......	.. ...	......
29	Blyth's Reed Warbler ...	1–2 believed seen March/April 44, but identity not proved.	1–2 suspected, but indentity not proved.	......	......	......
30	Indian Tailor Bird ...	fairly plentiful.	fairly plentiful.	often a few.	......	usually 1–2.
31	Burmese Tailor Bird ...	1-2 believed seen.	......	......	......	......
32	Booted Warbler or Syke's Tree Warbler (*Hippolais caligata*).	1–2 believed seen in December 1943 but identity not proved.	......	......	......	......
33	Yellow-browed (Crowned) Willow Warbler (*Phylloscopus inornatus*).	......	......	......	......	believed always 1-2 about, but identity not proved.
34	Ashy Wren-Warbler (*Prinia socialis*).	......	2–3 believed seen, but identity not proved.	......	......	......
35	Indian Oriole ...	less plentiful than No. 36.	......	......	......	......
36	Black-headed Oriole ...	fairly plentiful.	plentiful.	not uncommon.	......	usually 1–2.
37	Grey-headed Myna ...	rather thinly distributed.	not very numerous.	sometimes a few.	......	usually 3–4.
38	Common Myna ...	numerous.	numerous.	fairly numerous.	fairly numerous.	always a few.
39	Bank Myna	less numerous than the other Mynas.	......	not uncommon.	not uncommon.	......
40	Jungle Myna	rather thinly distributed.	......	......	......	......
41	Pied Myna	numerous.	slightly more plentiful than No. 38.	fairly numerous; many nesting in the peepal trees.	fairly numerous.	usually a few.
42	Baya Weaver Bird ...	......	numerous in flocks.	......	......	......
43	White-throated Munia ...	......	not uncommon.	......	......	occasionally a few.
44	Indian House Sparrow ...	always a few about buildings.	......	occasionally 1–2 foraging.	......	......

III. JUNGLE GROUP—(*Contd.*)

No.	SPECIES	MIXED JESSORE	JUNGLE DHUBALIA	ROADSIDE TREES JESSORE	GROVES OF PALMS JESSORE	MANGO GROVE DHUBALIA
15	Red-breasted Flycatcher ..	evidently a winter visitor, thinly distributed.	numerous.	......	1–2 seen Oct. 43—Jan. 44.	after 1–10–44, always 1–2 about.
16	Verditer Flycatcher *Eumyias thalassina*).	a single bird seen on 24-2-1944.	......	......	......	......
17	Paradise Flycatcher (*Tchitrea paradisi*).	rather thinly distributed during cold season; not seen at other times.	......	......	......	1, possibly 2 seen mid-Oct.
18	Black-naped Flycatcher ...	usually a few to be seen.	......	......	......	1 seen definitely once; presence often suspected.
19	White-browed Fantail Flycatcher.	rather thinly distributed.	a few about.	.. .	......	usually 1 about.
20	Bay-backed Shrike ..	......	......	a few.	a few.	......
21	Black-headed Shrike ...	......	......	......	a few in winter.	......
22	Rufous-backed Shrike ...	......	......	a few.	a few.	......
23	Brown Shrike ...	......	very numerous at first, less so towards end of survey period.	......	......	......
24	Common Wood-Shrike ..	not uncommon	not uncommon.	a few.	......	not uncommon.
25	Little Minivet .	not uncommon	......	....	......	not uncommon.
26	Ashy Swallow-Shrike ..	usually a few about.	a few seen.	.....	......	......
27	Black Drongo ...	abundant.	plentiful.	fairly numerous.	fairly numerous.	always a few.
28	White-bellied Drongo ...	a small party believed seen 17-2-44.	.. ...	. .	. .	..
29	Blyth's Reed Warbler ..	1–2 believed seen March/April 44, but identity not proved.	1–2 suspected, but identity not proved.	......	......	......
30	Indian Tailor Bird ...	fairly plentiful.	fairly plentiful.	often a few.	...	usually 1–2.
31	Burmese Tailor Bird . .	1–2 believed seen.	......	.....	... ..	......
32	Booted Warbler or Syke's Tree Warbler (*Hippolais caligata*).	1–2 believed seen in December 1943 but identity not proved.	......	......	...	......
33	Yellow-browed (Crowned) Willow Warbler (*Phylloscopus inornatus*).	.. ...	......	.. ...	.. ...	believed always 1-2 about, but identity not proved.
34	Ashy Wren-Warbler (*Prinia socialis*).	.. ...	2–3 believed seen, but identity not proved.	.. ...	......	. ...
35	Indian Oriole ...	less plentiful than No. 36.	......	......	......	......
36	Black-headed Oriole ..	fairly plentiful.	plentiful.	not uncommon.	......	usually 1–2.
37	Grey-headed Myna .	rather thinly distributed.	not very numerous.	sometimes a few.	......	usually 3–4.
38	Common Myna ...	numerous.	numerous.	fairly numerous.	fairly numerous.	always a few.
39	Bank Myna	less numerous than the other Mynas.	......	not uncommon.	not uncommon.	......
40	Jungle Myna	rather thinly distributed.	......	......	......	......
41	Pied Myna	numerous.	slightly more plentiful than No. 38.	fairly numerous; many nesting in the peepal trees.	fairly numerous.	usually a few.
42	Baya Weaver Bird ...	......	numerous in flocks.	......	......	......
43	White-throated Munia ...		not uncommon.	......	......	occasionally a few.
44	Indian House Sparrow ...	always a few about buildings.	......	occasionally 1–2 foraging.	.. ...	......

III. JUNGLE GROUP (*Contd.*)

No.	SPECIES	MIXED JUNGLE		ROADSIDE TREES	GROVES OF PALMS	MANGO GROVE
		JESSORE	DHUBALIA	JESSORE	JESSORE	DHUBALIA
45	Blue-headed Wagtail (*Motacilla flava beema*) ...	......	......	......	......	one believed seen once foraging in an open space.
46	Grey-headed Wagtail (*Motacilla f. thunbergi*).	1 believed seen on 26-11-43. This might have been a Blue-headed Wagtail (45) but I think not as the head seemed darker & breast & throat yellower than in other birds of that species.	......	......	......	......
47	Yellow-headed Wagtail ...	several seen about tanks in this type.	......	......	......	......
48	Indian Tree Pipit (*Anthus hodgsoni*).	several seen regularly in Jan. and Feb. 1944 and less often in March.	......	......	......	small numbers present on and after 6-12-44.
49	Indian Pipit	......	......	several believed seen but identity not proved.	......	......
50	White-eye (*Zosterops palpebrosa*).	a few seen occasionally.	......	......	......	......
51	Purple Sunbird ...	fairly numerous.	......	......	......	......

52	Purple-rumped Sunbird ...	do. I think slightly more so than No. 51.	fairly plentiful.	......	......	usually 1–2.
53	Tickell's Flowerpecker ...	not uncommon; probably often overlooked.	a few seen.	......	......	sometimes 1-2.
54	Thick-billed Flowerpecker (*Dicaeum agile*).	1 pair seen 25–2–44	......	......	......	......
55	Indian Pitta (*Pitta brachyura*).	1-2 seen in winter.	......	......	......	......
56	Little Scaly-bellied Green Woodpecker.	1-2 seen, but not plentiful.	......	......	......	......
57	Mahratta Woodpecker ...	not numerous.	1-2 seen.	......	......	1-2 seen.
58	Golden-backed Woodpecker	plentiful.	fairly plentiful.	not uncommon.	no uncommon.	always 1-2.
59	Tickell's Golden-backed Woodpecker.	fairly plentiful.	......	......	......	......
60	Wryneck (*Jynx torquilla*).	1 seen on 24–2–44.	......	......	......	......
61	Green Barbet ...	plentiful.	......	not uncommon.	......	......
62	Assam Lineated Barbet (*Megalaima lineatus*).	2 believed seen on 22–3–44.	......	......	......	......
63	Blue-throated Barbet ...	plentiful.	fairly plentiful.	occasionally seen.	......	1 seen several times.
64	Coppersmith	fairly plentiful.	ditto.	not uncommon.	......	usually 1–2.
65	Indian Cuckoo ...	appeared to be abundant; called regularly March-Aug.	......	......	......	......
66	Common Hawk Cuckoo ...	abundant.	a few about, but usually rather silent.	a few.	......	......
67	Indian Plaintive Cuckoo ...	1 believed heard fairly often in April 44, but never seen.	a few seen and heard.	......	......	......
68	Pied Crested Cuckoo ...	a few conspicuous in July/Aug. but not noticed at other times.	a few seen in Sept. '44.	......	......	......
69	Koel	abundant.	fairly plentiful.	occasionally seen.	......	1 sometimes seen.

III. JUNGLE GROUP (*Contd.*)

No.	SPECIES	MIXED JUNGLE		ROADSIDE TREES	GROVES OF PALMS	MANGO GROVE
		JESSORE	DHUBALIA	JESSORE	JESSORE	DHUBALIA
45	Blue-headed Wagtail (*Motacilla flava beema*) ...	......	......	......	......	one believed seen once foraging in an open space.
46	Grey-headed Wagtail (*Motacilla f. thunbergi*).	1 believed seen on 26-11-43. This might have been a Blue-headed Wagtail (45) but I think not as the head seemed darker & breast & throat yellower than in other birds of that species.	......	......	......	......
47	Yellow-headed Wagtail ...	several seen about tanks in this type.	......	......	......	......
48	Indian Tree Pipit (*Anthus hodgsoni*).	several seen regularly in Jan. and Feb. 1944 and less often in March.	......	......	......	small numbers present on and after 6-12-44.
49	Indian Pipit	......	......	several believed seen but identity not proved.	......	......
50	White-eye (*Zosterops palpebrosa*).	a few seen occasionally.	......	......	......	......
51	Purple Sunbird ...	fairly numerous.	......	......	......	.. ..
52	Purple-rumped Sunbird ...	do. I think slightly more so than No. 51.	fairly plentiful.	......	......	usually 1-2.
53	Tickell's Flowerpecker ...	not uncommon; probably often overlooked.	a few seen.	......	......	sometimes 1-2.
54	Thick-billed Flowerpecker (*Dicaeum agile*).	1 pair seen 25-2-44	......	......	......	......
55	Indian Pitta (*Pitta brachyura*).	1-2 seen in winter.	......	......	......	......
56	Little Scaly-bellied Green Woodpecker.	1-2 seen, but not plentiful.	......	... ..	......	......
57	Mahratta Woodpecker ...	not numerous.	1-2 seen.	......	......	1-2 seen.
58	Golden-backed Woodpecker	plentiful.	fairly plentiful.	not uncommon.	no uncommon.	always 1-2.
59	Tickell's Golden-backed Woodpecker.	fairly plentiful.	......	......	......	......
60	Wryneck (*Jynx torquilla*).	1 seen on 24-2-44.	......	.. ...	.. ...	......
61	Green Barbet ...	plentiful.	......	not uncommon.	......	......
62	Assam Lineated Barbet (*Megalaima lineatus*).	2 believed seen on 22-3-44.	......	......	......	......
63	Blue-throated Barbet ...	plentiful.	fairly plentiful.	occasionally seen.	......	1 seen several times.
64	Coppersmith	fairly plentiful.	ditto.	not uncommon.	......	usually 1-2.
65	Indian Cuckoo ...	appeared to be abundant; called regularly March-Aug.	......	......	......	.....
66	Common Hawk Cuckoo ...	abundant.	a few about, but usually rather silent.	a few.	......	......
67	Indian Plaintive Cuckoo ...	1 believed heard fairly often in April 44, but never seen.	a few seen and heard.	......	......	......
68	Pied Crested Cuckoo ...	a few conspicuous in July/Aug. but not noticed at other times.	a few seen in Sept. '44.	......	......	......
69	Koel	abundant.	fairly plentiful.	occasionally seen.	......	1 sometimes seen.

III. JUNGLE GROUP—(*Contd.*)

No.	SPECIES	MIXED JUNGLE		ROADSIDE TREES	GROVES OF PALMS	MANGO GROVE
		JESSORE	DHUBALIA	JESSORE	JESSORE	DHUBALIA
70	Crow Pheasant ...	plentiful.	fairly plentiful.	......	...	......
71	Large Parrakeet ...	occasionally seen; ? subspecies.	not very numerous.	occasionally seen.	......	......
72	Blossom-headed Parrakeet (*Psittacula cyanocephala*).	......	1-2 seen.	......	......	......
73	Roller	fairly plentiful, tho' less so than in some other places in the Plains.	rather thinly distributed.	not uncommon.	not uncommon.	......
74	Green Bee-eater ...	abundant.	abundant.	abundant.	abundant.	numerous about edges of grove.
75	Pied Kingfisher ...	a few seen about tanks.	......	......	......	......
76	Common Indian Kingfisher	fairly plentiful about the tanks.	......	......	......	......
77	Stork-billed Kingfisher ...	fairly plentiful.	a few about.	......	......	......
78	White-breasted Kingfisher.	plentiful.	fairly plentiful, but I think less so than at Jessore.	fairly plentiful.	fairly plentiful; often perched on the palm trees.	......
79	House Swift ...	fairly plentiful.	......	......	......	......
80	Palm Swift ...	do.	......	......	numerous.	......
81	Horsfield's Nightjar ...	always 1–2 to be heard at night.	a few heard.	......	......	1 occasionally called at night.
82	Mottled Wood Owl (*Strix ocellata*).	not uncommon.	......	one seen.	......	......
83	Brown Fish Owl (*Ketupa zeylonensis*).	1 picked up dead, apparently killed by a vehicle.	......	......	......	......

84	Collared Scops Owlet ...	1–2 believed always to be heard at night but voice was only means of identification.	believed fairly plentiful.	1–2 believed seen.	......	1 believed to call regularly at night.
85	Jungle Owlet ...	1–2 believed heard now and again.	fairly plentiful.	one seen.	......	one ditto.
86	King Vulture ...	abundant.	do	......	......	......
87	Long-billed Vulture ...	fairly plentiful.	do.	......	......	......
88	White-backed Vulture ...	abundant.	do.	......	......	......
89	Crested Serpent Eagle ...	usually 1–2 about.	usually 1–2 about.	......	......	......
90	Pallas's Fishing Eagle (*Häliaëtus leucoryphus*).	a few believed to be present, but not proved beyond doubt.	......	......	......	......
91	Grey-headed Fishing Eagle (*Ichthyophaga ichthyaëtus*).	a few usually about.	......	......	......	......
92	Brahminy Kite ...	plentiful.	a few about.	not uncommon.	not uncommon.	......
93	Pariah Kite ...	ubiquitous.	fairly plentiful.	ditto, but usually kept nearer human habitation.	ditto, but usually kept nearer human habitation.	always a few.
94	Common Green Pigeon (*Crocopus phoenicopterus*)	presence strongly suspected but not proved ; specimens shot a few miles away.	......	......	......	......
95	Imperial Green Pigeon (*Muscadivora aenea*).	1 believed seen.	......	......	......	......
96	Blue Rock Pigeon ...	fairly plentiful.	a few about.	not numerous.	not numerous.	......
97	Rufous Turtle Dove ...	do.	......	fairly plentiful.	fairly plentiful.	......
98	Spotted Dove ...	do.	abundant.	do.	do.	always 1–2.
99	Indian Ring Dove ...	......	do.	do.	not uncommon.	sometimes 1–2.
100	Red Turtle Dove ...	fairly plentiful.	fairly plentiful.	do.	do.	do.
101	Common Bustard Quail ...	......	......	......	......	on 11-12-44 three foraged on edge of grove.

III. JUNGLE GROUP—(*Contd.*)

No.	SPECIES	MIXED JUNGLE		ROADSIDE TREES	GROVES OF PALMS	MANGO GROVE
		JESSORE	DHUBALIA	JESSORE	JESSORE	DHUBALIA
70	Crow Pheasant ...	plentiful.	fairly plentiful.	.. ...	...	.....
71	Large Parrakeet ...	occasionally seen; ? subspecies.	not very numerous.	occasionally seen.	.. ...	......
72	Blossom-headed Parrakeet (*Psittacula cyanocephala*).	......	1-2 seen.	......	......	......
73	Roller	fairly plentiful, tho' less so than in some other places in the Plains.	rather thinly distributed.	not uncommon.	not uncommon.	......
74	Green Bee-eater ...	abundant.	abundant.	abundant.	abundant.	numerous about edges of grove.
75	Pied Kingfisher ...	a few seen about tanks.	... ..	......	... ..	......
76	Common Indian Kingfisher	fairly plentiful about the tanks.	......	......	......	......
77	Stork-billed Kingfisher ...	fairly plentiful.	a few about.	......	......	......
78	White-breasted Kingfisher.	plentiful.	fairly plentiful, but I think less so than at Jessore.	fairly plentiful.	fairly plentiful; often perched on the palm trees.	......
79	House Swift ..	fairly plentiful.	......	......	......	......
80	Palm Swift ...	do.	......	......	numerous.	......
81	Horsfield's Nightjar ..	always 1–2 to be heard at night.	a few heard.	......	......	1 occasionally called at night.
82	Mottled Wood Owl (*Strix ocellata*).	not uncommon.	......	one seen.	......	......
83	Brown Fish Owl (*Ketupa zeylonensis*).	1 picked up dead, apparently killed by a vehicle.	......	......	......	......
84	Collared Scops Owlet ...	1-2 believed always to be heard at night but voice was only means of identification.	believed fairly plentiful.	1–2 believed seen.	.....	1 believed to call regularly at night.
85	Jungle Owlet ...	1–2 believed heard now and again.	fairly plentiful.	one seen.	......	one ditto.
86	King Vulture ..	abundant.	do	.. ...	... ..	......
87	Long-billed Vulture ...	fairly plentiful.	do.	......	......	......
88	White-backed Vulture ...	abundant.	do.	... .	... ..	.. ...
89	Crested Serpent Eagle ...	usually 1–2 about.	usually 1–2 about.	. ...	......	......
90	Pallas's Fishing Eagle (*Haliaëtus leucoryphus*).	a few believed to be present, but not proved beyond doubt.	... ..	.. ..	......	......
91	Grey-headed Fishing Eagle (*Ichthyophaga ichthyaëtus*).	a few usually about.	.. ..	... ..	...	.. ...
92	Brahminy Kite ...	plentiful.	a few about.	not uncommon.	not uncommon.	... ..
93	Pariah Kite ...	ubiquitous.	fairly plentiful.	ditto, but usually kept nearer human habitation.	ditto, but usually kept nearer human habitation.	always a few.
94	Common Green Pigeon (*Crocopus phoenicopterus*)	presence strongly suspected but not proved; specimens shot a few miles away.	.. ...	......	......	......
95	Imperial Green Pigeon (*Muscadivora aenea*).	1 believed seen.	......	......	.. ...	.. ...
96	Blue Rock Pigeon ...	fairly plentiful.	a few about.	not numerous.	not numerous.	......
97	Rufous Turtle Dove ...	do.	... ...	fairly plentiful.	fairly plentiful.	......
98	Spotted Dove ...	do.	abundant.	do.	do.	always 1–2.
99	Indian Ring Dove ...	......	do.	do.	not uncommon.	sometimes 1–2.
100	Red Turtle Dove ...	fairly plentiful.	fairly plentiful.	do.	do.	do.
101	Common Bustard Quail ...	......	......	.... .	......	on 11-12-44 three foraged on edge of grove.

III. Jungle Group—(*Contd*).

No.	SPECIES	MIXED JUNGLE		ROADSIDE TREES	GROVES OF PALMS	MANGO GROVE
		JESSORE	DHUBALIA	JESSORE	JESSORE	DHUBALIA
102	White-breasted Waterhen.	......	a few usually foraging about bushes &c. in evening.	one seen.	......	......
103	River Tern (*Sterna aurantia*).	......	1 seen several times at tanks in rough jungle.	......	......	......
104	Green Sandpiper ...	not uncommon about the tanks.	......	......	......	......
105	Wood Sandpiper (*Tringa glareola*).	ditto, but not quite so numerous.	......	......	......	......
106	Cattle Egret ...	fairly numerous.	a few.	......	......	several once fed about cattle under the trees.
107	Indian Pond Heron ...	numerous.	a few.	......	......	......

IV. Waste Land Group

No.	SPECIES	WASTE LAND UNDER GRASS		SEMI-MARSH	MARSH
		JESSORE	DHUBALIA	DHUBALIA	JESSORE
1	Jungle Crow	fairly plentiful.	usually a few.	usually a few.	......
2	House Crow	less numerous than No. 1.	......	......	......
3	Common Iora	......	......	one seen once.	......
4	Red-vented Bulbul	not uncommon foraging.	......	usually a few.	not uncommon foraging about the edge.
5	Red-whiskered Bulbul	......	......	......	do.
6	Indian Bush Chat (*Saxicola torquata*).	......	......	usually 1–2 about.	......
7	Magpie Robin	not uncommon foraging.	......	......	not uncommon foraging about the edge.
8	Bay-backed Shrike	rather thinly distributed.	......	......	not uncommon.
9	Black-headed Shrike	a few in winter	......	......	a few in winter.
10	Rufous-backed Shrike	a few.	......	......	a few.
11	Brown Shrike	......	......	always a few about, but fewer towards end of survey period.	......
12	Little Minivet	......	......	......	a few; they would cling to the stems of marsh grass.
13	Ashy Swallow Shrike	......	......	a few seen Sept.—Oct.	......
14	Black Drongo	plentiful.	always a few.	always a few.	plentiful.
15	Grey-headed Myna	......	......	usually a few.	a few sometimes bathing.
16	Common Myna	plentiful.	always some about.	always some about.	plentiful about edge.
17	Bank Myna	......	......	2—3 seen once.	......
18	Pied Myna	plentiful.	always some about.	always some about.	plentiful about edge.
19	Chestnut-bellied Munia (*Munia atricapilla*).	2 seen twice in July 1944.	......	......	......

IV. WASTE LAND GROUP—(*Contd.*)

No.	SPECIES	WASTE LAND UNDER GRASS		SEMI-MARSH	MARSH
		JESSORE	DHUBALIA	DHUBALIA	JESSORE
20	White-throated Munia	one party seen once in summer.	......	usually a few; one found nesting 12-10-44.	......
21	Indian Cliff Swallow	......	usually a few foraging.	......	......
22	Blue-headed Wagtail	......	......	always a few near the river and jheels.	......
23	Yellow-headed Wagtail	......	......	......	not uncommon.
24	Indian Pipit	......	......	always a few.	......
25	Bengal Bush Lark	a few seen.	......	do.	......
26	Roller	somewhat thinly distributed.	......	......	......
27	Green Bee-eater	abundant.	always some present.	fairly numerous.	abundant.
28	Blue-tailed Bee-eater	......	......	usually a few.	......
29	White-breasted Kingfisher ...	fairly plentiful.	......	......	fairly plentiful; seen perching on tall grasses.
30	Common Indian Kingfisher ...	fairly plentiful.	......	a few seen.	fairly plentiful.
31	Hoopoe	2 seen January-February 1944.	......	2 seen 13-10-44.	......
32	Indian Swift	fairly plentiful foraging.	......	......	fairly plentiful, foraging.
33	Palm Swift	do., and nesting.	always a few.	......	do.
34	King Vulture	abundant.	usually a few soaring.	soaring.	soaring.
35	Long-billed Vulture	......	do.	do.	do.
36	White-backed Vulture ...	abundant.	do.	do.	do.
37	Laggar Falcon (*Falco jugger*) ...	1 seen occasionally.	......	......	......
38	Indian Kestrel (*Falco tinnunculus*).	......	......	one seen once.	......

39	Crested Serpent Eagle	usually 1-2 to be seen.	......	......	1-2 usually soaring, or perched in trees at edge.
40	Pallas's Fishing Eagle	1 believed seen several times, but identity not proved.	......	......	1-2 believed seen several times but identity not proved.
41	Grey-headed Fishing Eagle	a few seen.	......	......	a few seen.
42	Brahminy Kite	plentiful.	......	usually a few.	plentiful.
43	Pariah Kite	ubiquitous.	plentiful.	......	often seen at edge and flying above.
44	Black-winged Kite (*Elanus coeruleus*)	one shot just outside survey area.	......	......	......
45	Pied Harrier (*Circus melanoleucus*).	1 seen April-June 1944.	......	......	......
46	Marsh Harrier (*C. aeruginosus*)	......	......	usually a ♂ and often 1 ♀ present	1 pair usually present
47	Shikra	1-2 occasionally seen.	......	one seen once.	......
48	Blue Rock Pigeon	fairly plentiful.	......	......	......
49	Rufous Turtle Dove	do. wherever there was cover.	......	......	......
50	Spotted Dove	do.	always a few.	fairly plentiful.	......
51	Indian Ring Dove	......	usually a few.	usually a few.	......
52	Red Turtle Dove	fairly plentiful wherever there was cover.	often a few.	occasionally 1-2.	......
53	Grey Partridge	......	......	usually a few	......
54	Painted Snipe	......	......	shot in district.	......
55	Indian Stone Curlew	......	often a few : one shot on 6-12-44.	......	......
56	Red-wattled Lapwing	not uncommon.	......	usually a few.	......
57	Green Sandpiper	......	......	usually 1-2 about the damper places.	not uncommon.
58	Wood Sandpiper	......	......	do.	do. but I think a little more plentiful.
59	Pintail Snipe (*Capella stenura*)	......	......	one seen once.	......
60	Open-bill Stork (*Anastomus oscitans*).	......	......	several seen.	......
61	Grey Heron (*Ardea cinerea*)	......	......	2 seen flying here.	......
62	Cattle Egret	fairly plentiful.	......	often a few about.	fairly plentiful.
63	Indian Pond Heron	fairly plentiful.	......	do.	do.
64	Lesser Whistling Teal	2 seen on 31-7-44.	......	a few seen flying.	......

IV. WASTE LAND GROUP—(*Contd.*)

No.	SPECIES	WASTE LAND UNDER GRASS		SEMI-MARSH	MARSH
		JESSORE	DHUBALIA	DHUBALIA	JESSORE
20	White-throated Munia	one party seen once in summer.	......	usually a few; one found nesting 12-10-44.	......
21	Indian Cliff Swallow	......	usually a few foraging.	......	......
22	Blue-headed Wagtail	......	......	always a few near the river and jheels.	......
23	Yellow-headed Wagtail	......	......	......	not uncommon.
24	Indian Pipit	......	......	always a few.	......
25	Bengal Bush Lark	a few seen.	......	do.	......
26	Roller	somewhat thinly distributed.	......	......	......
27	Green Bee-eater	abundant.	always some present.	fairly numerous.	abundant.
28	Blue-tailed Bee-eater	......	......	usually a few.	......
29	White-breasted Kingfisher	fairly plentiful.	......	......	fairly plentiful; seen perching on tall grasses.
30	Common Indian Kingfisher	fairly plentiful.	......	a few seen.	fairly plentiful.
31	Hoopoe	2 seen January-February 1944.	......	2 seen 13-10-44.	......
32	Indian Swift	fairly plentiful foraging.	......	......	fairly plentiful, foraging.
33	Palm Swift	do., and nesting.	always a few.	......	do.
34	King Vulture	abundant.	usually a few soaring.	soaring.	soaring.
35	Long-billed Vulture	......	do.	do.	do.
36	White-backed Vulture	abundant.	do.	do.	do.
37	Laggar Falcon (*Falco jugger*)	1 seen occasionally.	......	......	......
38	Indian Kestrel (*Falco tinnunculus*).	......	......	one seen once.	......
39	Crested Serpent Eagle	usually 1–2 to be seen.	......	......	1–2 usually soaring, or perched in trees at edge.
40	Pallas's Fishing Eagle	1 believed seen several times, but identity not proved.	......	......	1–2 believed seen several times but identity not proved.
41	Grey-headed Fishing Eagle	a few seen.	......	......	a few seen.
42	Brahminy Kite	plentiful.	......	usually a few.	plentiful.
43	Pariah Kite	ubiquitous.	plentiful.	......	often seen at edge and flying above.
44	Black-winged Kite (*Elanus coeruleus*)	one shot just outside survey area.	......	......	......
45	Pied Harrier (*Circus melanoleucus*).	1 seen April-June 1944.	......	......	......
46	Marsh Harrier (*C. aeruginosus*)	......	......	usually a ♂ and often 1 ♀ present	1 pair usually present
47	Shikra	1–2 occasionally seen.	......	one seen once.	......
48	Blue Rock Pigeon	fairly plentiful.	......	......	......
49	Rufous Turtle Dove	do. wherever there was cover.	......	......	......
50	Spotted Dove	do.	always a few.	fairly plentiful.	......
51	Indian Ring Dove	......	usually a few.	usually a few.	......
52	Red Turtle Dove	fairly plentiful wherever there was cover.	often a few.	occasionally 1–2.	......
53	Grey Partridge	......	......	usually a few	......
54	Painted Snipe	......	......	shot in district.	......
55	Indian Stone Curlew	......	often a few : one shot on 6-12-44.	......	......
56	Red-wattled Lapwing	not uncommon.	......	usually a few.	......
57	Green Sandpiper	......	......	usually 1–2 about the damper places.	not uncommon.
58	Wood Sandpiper	......	......	do.	do. but I think a little more plentiful.
59	Pintail Snipe (*Capella stenura*)	......	......	one seen once.	......
60	Open-bill Stork (*Anastomus oscitans*).	......	......	several seen.	......
61	Grey Heron (*Ardea cinerea*)	......	......	2 seen flying here.	......
62	Cattle Egret	fairly plentiful.	......	often a few about.	fairly plentiful.
63	Indian Pond Heron	fairly plentiful.	......	do.	do.
64	Lesser Whistling Teal	2 seen on 31-7-44.	......	a few seen flying.	......

V. INLAND WATER GROUP

No.	SPECIES	SMALL RIVER		JHEELS and TANKS	
		JESSORE	DHUBALIA	JESSORE	DHUBALIA
1	Jungle Crow	usually a few about.	......	often seen drinking.	often a few.
2	House Crow	do.	......	do.	......
3	Black Drongo	plentiful.	fairly plentiful.	plentiful.	fairly plentiful.
4	Common Myna	numerous.	often a few.	numerous.	often a few.
5	Pied Myna	do.	do.	do.	do.
6	Cliff Swallow	......	usually a few.	......	......
7	Indian White Wagtail	......	1-2 seen 15-10-44.	......	......
8	White-faced Wagtail	a few seen in winter.	1-2 seen 15-10-44.	......	......
9	Blue-headed Wagtail	......	always a few.	......	usually a few.
10	Yellow-headed Wagtail... ...	several seen in winter.	......	several seen in winter.	......
11	Bengal Bush Lark	......	often 1-2 foraging at edge.	......	......
12	Green Bee-eater	very plentiful.	fairly numerous.	very plentiful.	fairly numerous.
13	Blue-tailed Bee-eater	......	often a few.	......	......
14	Pied Kingfisher	......	a few seen.	......	1-2 seen.
15	Common Indian Kingfisher ...	fairly plentiful.	do.	......	a few seen.
16	White-breasted Kingfisher ...	plentiful.	do.	plentiful.	do.
17	Palm Swift	......	usually a few.	......	......
18	Osprey (*Pandion haliaëtus*) ...	......	usually at least 2 present.	......	usually at least two present.
19	Crested Serpent Eagle	not uncommonly perching on trees on bank.	......	......	......
20	Pallas's Fishing Eagle	a few believed present but identity not proved.	......	......	......
21	Grey-headed Fishing Eagle ...	a few usually about.	......	......	......
22	Brahminy Kite	plentiful.	usually a few about.	plentiful.	usually a few about.
23	Pariah Kite	ubiquitous.	......	ubiquitous.	a few often about.
24	White-breasted Waterhen ...	......	......	......	a few.

25	Indian Moorhen (*Gallinula chloropus*.	......	......	reported on fairly good authority.	.....
26	Purple Moorhen (*Porphyrio poliocephalus*).	......	......	shot on another jheel just outside survey area.	......
27	Common Coot (*Fulica atra*) ...	a few.	......	a few.	......
28	Bronze-winged Jacana	fairly plentiful.	......	fairly plentiful.	always a few about the weedier parts.
29	Pheasant-tailed Jacana	not numerous.	......	not numerous.	......
30	Pintail Snipe	......	one shot.	......	......
31	Whiskered Tern (*Chlidonias hybrida*).	......	believed usually 1–2 about, but identity not proved.	......	believed usually 1–2 about but identity not proved.
32	Gull-billed Tern (*Gelochelidon nilotica*).	1–2 believed seen, but identity not proved; beak in each case looked black and legs vermillion.	......	......	......
33	Common River Tern	......	believed usually 1–2 about but identity not proved.	......	believed usually 1–2 about but identity not proved.
34	Black-bellied Tern (*Sterna melanogaster*).	......	reported on fairly good authority from just outside survey area, but not seen by me.	.....	......
35	Red-wattled Lapwing ...	......	fairly plentiful.	......	1–2 occasionally seen.
36	Green Sandpiper ...	not uncommon.	do.	not uncommon.	fairly plentiful.
37	Wood Sandpiper ...	do.	do.	ditto; slightly more plentiful.	do.
38	Greenshank (*Tringa nebularia*) ...	......	......	......	1–2 seen.
39	Common Sandpiper (*Actitis hypoleucos*).	......	fairly plentiful tho' less so than Nos. 36 & 37.	......	fairly plentiful, tho' less so than Nos. 36 & 37.
40	Large Cormorant (*Phalacrocorax carbo*).	......	......	reported on fairly good authority from a jheel just outside survey area	......

V. INLAND WATER GROUP

No.	SPECIES	SMALL RIVER		JHEELS and TANKS	
		JESSORE	DHUBALIA	JESSORE	DHUBALIA
1	Jungle Crow	usually a few about.	......	often seen drinking.	often a few.
2	House Crow	do.	......	do.	......
3	Black Drongo	plentiful.	fairly plentiful.	plentiful.	fairly plentiful.
4	Common Myna	numerous.	often a few.	numerous.	often a few.
5	Pied Myna	do.	do.	do.	do.
6	Cliff Swallow	......	usually a few.	......	......
7	Indian White Wagtail	......	1–2 seen 15-10-44.	......	......
8	White-faced Wagtail	a few seen in winter.	1–2 seen 15-10-44.	......	......
9	Blue-headed Wagtail	.. ...	always a few.	......	usually a few.
10	Yellow-headed Wagtail... ...	several seen in winter.	......	several seen in winter.	......
11	Bengal Bush Lark	......	often 1–2 foraging at edge.	......	......
12	Green Bee-eater	very plentiful.	fairly numerous.	very plentiful.	fairly numerous.
13	Blue-tailed Bee-eater	......	often a few.	......	......
14	Pied Kingfisher	......	a few seen.	......	1–2 seen.
15	Common Indian Kingfisher ...	fairly plentiful.	do.	......	a few seen.
16	White-breasted Kingfisher ...	plentiful.	do.	plentiful.	do.
17	Palm Swift	......	usually a few.	......	......
18	Osprey (*Pandion haliaëtus*) ...	......	usually at least 2 present.	......	usually at least two present.
19	Crested Serpent Eagle	not uncommonly perching on trees on bank.	......	......	......
20	Pallas's Fishing Eagle	a few believed present but identity not proved.	......	......	......
21	Grey-headed Fishing Eagle ...	a few usually about.	......	......	......
22	Brahminy Kite	plentiful.	usually a few about.	plentiful.	usually a few about.
23	Pariah Kite	ubiquitous.	......	ubiquitous.	a few often about.
24	White-breasted Waterhen ...	......	......	......	a few.
25	Indian Moorhen (*Gallinula chloropus*.	......	......	reported on fairly good authority.	... ..
26	Purple Moorhen (*Porphyrio poliocephalus*).	......	......	shot on another jheel just outside survey area.	... ..
27	Common Coot (*Fulica atra*) ...	a few.	......	a few.	......
28	Bronze-winged Jacana	fairly plentiful.	......	fairly plentiful.	always a few about the weedier parts.
29	Pheasant-tailed Jacana	not numerous.	......	not numerous.	......
30	Pintail Snipe	......	one shot.	......	......
31	Whiskered Tern (*Chlidonias hybrida*).	... ..	believed usually 1–2 about, but identity not proved.	......	believed usually 1–2 about but identity not proved.
32	Gull-billed Tern (*Gelochelidon nilotica*).	1–2 believed seen, but identity not proved; beak in each case looked black and legs vermillion.	......	......	......
33	Common River Tern	......	believed usually 1–2 about but identity not proved.	......	believed usually 1–2 about but identity not proved.
34	Black-bellied Tern (*Sterna melanogaster*).	......	reported on fairly good authority from just outside survey area, but not seen by me.	......	......
35	Red-wattled Lapwing ...	......	fairly plentiful.	......	1–2 occasionally seen.
36	Green Sandpiper ...	not uncommon.	do.	not uncommon.	fairly plentiful.
37	Wood Sandpiper ...	do.	do.	ditto ; slightly more plentiful.	do.
38	Greenshank (*Tringa nebularia*) ...	... ..	......	......	1–2 seen.
39	Common Sandpiper (*Actitis hypoleucos*).	.. ...	fairly plentiful tho' less so than Nos. 36 & 37.	......	fairly plentiful, tho' less so than Nos. 36 & 37
40	Large Cormorant (*Phalacrocorax carbo*).	......	......	reported on fairly good authority from a jheel just outside survey area	......

V. Inland Water Group—(*Contd.*)

No,	SPECIES	SMALL RIVER		JHEELS and TANKS	
		Jessore	Dhubalia	Jessore	Dhubalia
41	Little Cormorant ...	fairly plentiful.	......	......	usually a few about; flights passed over every evening.
42	Indian Darter (*Anhinga melanogaster*).	......	......	reported on fairly good authority from a jheel just outside the survey area.	......
43	Grey Heron ...	......	2 seen once.	......	......
44	Large Egret (*Egretta alba*) ...	.. ...	1–2 seen.	......	1–2 seen.
45	Little Egret ...	......	fairly plentiful.	......	always a few.
46	Cattle Egret ...	fairly plentiful.	do.	fairly plentiful.	fairly plentiful.
47	Indian Pond Heron ...	do.	abundant.	do.	do.
48	Cotton Teal ...	......	......	not uncommon, at any rate during rainy season.	......
49	Lesser Whistling Teal ...	......	several seen.	do.	......

GAME SANCTUARIES IN BURMA (PRE-1942)
WITH PRESENT STATUS OF RHINOCEROS AND THAMIN

BY

LIEUT.-COL. R. W. BURTON, I.A. (Retd.)

(With two plates)

Prior to the Japanese invasion and the subsequent grant of independent status to Burma, early in 1948, there were several Game Sanctuaries in the 50,000 square miles of Government Forest in that country; and the total area under forest was about 240,000 square miles.

There was the Shwe-u-daung Sanctuary of about 81 square miles of mostly hilly country in the Momeik and Mogok Forest Divisions in Upper Burma; the Kahilu Game Sanctuary of 62 square miles in the Thaton and Salween Forest Divisions of Lower Burma; the two sanctuaries of Maymyo and the Moscos Islands which were merely wild bird refuges of 49 and 19 square miles respectively; and the Pidoung Sanctuary here described.

THE VANISHING RHINOCEROS

The position of the three Asiatic species of rhinoceros in the above sanctuaries and elsewhere was fully discussed and brought up to date (1947) by Ansell [Vol. 47 (2) pp. 249-276], his conclusion being that *R. sondaicus* had become virtually extinct in Burma, also in Malaya, Siam, Sumatra, Java and Borneo: while as to *Dicerorhinus sumatrensis* the lowest reasonable estimate was 21 animals in Burma, and perhaps as many as 45.

In view of the present state of law and order in Burma, and other eastern countries where the rhinoceros has hitherto existed, it can be safely conjectured that the species *sondaicus* is virtually extinct, and that *sumatrensis* may not survive beyond the present century. So we have the sad prospect of two more species being added to the many which have vanished from the world almost within living memory.

RHINOCEROS UNICORNIS

The preservation of this species rests with India and Nepal. In his article, 'Wild Life Reserves in India: Assam.' E. P. Gee [*J.B.N.H.S.*, Vol. 49, (1)] gives an estimate of the number of rhinoceros now existing in this country, based on the Society's report to the International Union for the Protection of Nature in 1949.

If the estimate of 50 for Nepal is near the actual figure then there has been a great diminution there of the species within the past forty years. A sportsman fishing in the Rapti river wrote on the 25th May 1909:—

'My principal fun was going out on an elephant photographing rhino . . . They are simply in swarms; I counted twenty within a mile of my camp, and I did not go into the good ground. There were ten big ones in a small piece of grass not more than 5 acres in extent.' [*J.B.N.H.S.*, Vol. 19 (3) pp. 747.]

A reliable census of the number of rhinoceros in Nepal at the present time would be of great interest. In the reference quoted above it is also authentically stated:—

'The rhinoceros is found in the Nepal Terai, in Morang, north of Purnea, on the Kosi at Pathargahatta, on the banks of the Bagmati north of Muzaffarpur, and as stated by Mr. Lydekker, it is even more numerous still farther to the west in the Chitwan and Naolpur valleys along the banks of the Gandak and the Rapti rivers . . . In spite of the numbers of rhino which were killed in January 1907 (there was a big shoot and twenty-eight rhinos were shot and six calves caught) the forests in Chitwan are still so full of them that no appreciable diminution in the stock has been made.'

RHINOCEROS SONDAICUS

At page 266 of his article Ansell remarks:—

'Regarding the existence of the species in other countries, I feel that the Sundarbans of S. Bengal may offer a little hope, though little is known about the number of rhinoceros, if any, that exist there today. Rhinoceros in this area, if any exist, would almost certainly be *sondaicus* as in all the available records no specimen of either *R. unicornis* or *D. sumatrensis* has been recorded from the area.'

In reference to the above the excellent article by Vicomte Edmond de Poncins, 'A Hunting Trip in the Sunderbunds in 1892.' [*J.B.N.H.S.*, Vol. 37, No 4 (1935).] is of considerable interest and value.

Besides much that is of interest to the sportsman-naturalist and the general reader, is the account of how he spent days and days tracking and observing the habits of the few *Rhinoceros sondaicus* which were to be found at that time on islands 165, 169, 170, 171, 172:—

'The rhinos lived there for one reason. In the middle of this jungle there was sweet water.'

Edmond de Poncins was obviously a reliable observer. He did not kill, or fire at even one of the animals:—

'. . . . finally I got a glimpse of a strange profile at a very short distance. For the first and, I am sorry to say, the last time in my life I saw that long, grey, hornless head and everything was explained: these rhinos were *R. sondaicus*, they had no trophy worth having, and shooting them was without excuse.

What has become of the Sunderbund rhinos now (1935) in spite of the extreme difficulty involved in their pursuit? They were then very few: I am certain of three, I consider that a fourth is probable, and that six is the maximum. They are probably shot out. Even when I was there, poaching was rife in the Sunderbunds.'

It is probable that not very long after 1892 the species will have been exterminated in the Sundarbans—and everywhere in India, including the Chittagong Hill Tracts where there might at that time have been a few of them. So of the three rhinoceroses of Asia it is only the *Rhinoceros unicornis* of India which is likely to survive into the next century: except perhaps for a few specimens in zoological gardens, as *sumatrensis* has been known to attain the age of 47 years in captivity.

Members interested in the status of the rhinoceros in Asia may see the list of references at end of this article.

THE PIDOUNG GAME SANCTUARY IN 1930

Of all the game sanctuaries in Burma, the Pidoung Sanctuary in the Myitkyina Forest Division of Upper Burma was alone suited for purposes of photography and observation of the wild life it contained, for it was readily accessible. It extended on both sides of the railway running for twenty miles through the area and was provided with a bungalow not far from the railway station about twelve miles from Myitkyina.

It was in May 1930 that the writer visited the Pidoung Sanctuary with the kind assistance of the then Game Warden of Burma, Mr. H. C. Smith, who made all camp arrangements, provided two riding elephants, and guided me and a Government Officer who was just beginning wild life photography so that we could see the sanctuary and its denizens under the best possible conditions. Things may have greatly changed since then so it will be best to continue in the present tense from notes made at the time.[1]

The area notified by the Government of Burma as the sanctuary comprises 260 square miles of forest country. There are hills and valleys, thick evergreen forests and more open jungle; while north of the railway station are rolling downs, bare of trees, in the hollows of which are dense thickets, also long winding green valleys filled with lush grass.

In this part of the sanctuary there is excellent stalking ground, so that the photographer who is so fortunate as to be under the skilful guidance of the Game Warden can obtain opportunities for beautiful and interesting pictures with whatever kind of camera he may possess. Care has to be taken not to alarm the game which is not yet wholly without fear of man. In time the animals will be as tame as fallow deer in the beautiful Parks of England, or the animals in the National Parks of America and other countries. Indeed, one need not go so far away as that to enjoy the sight of wild animals without fear of man, for in a quite small sanctuary in a Central India State the writer has seen sambar and other game of those parts literally as tame as village cattle; and in the Yala Sanctuary in Ceylon are animals almost as tame.

Here, at Pidoung, the present scribe, a humble wielder of a Kodak, managed to take several reasonably good pictures of a herd of grazing bison and one of a bull *saing*. But for the dull light and cloudy sky the bison photos might have been considerably better. It is during the months of April and May that the habits of bison and *saing* bring these splendid animals into the open to graze on the short green grass and be free as possible from the swarms of biting and stinging insects which so plague them at that season. *Saing* are the wild cattle of Burma, and of Malaya, where they are called *Banting*. They are also found on a number of islands of the Malayan Archipelago, even as far away as Borneo.

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[1] Shortly we hope to publish an up-to-date account of the Pidoung and other game sanctuaries to be supplied by the present Chief Conservator of Forests of independent Burma.—EDS.

The bulls are massive animals attaining a height of nearly 17 hands, and vary in colour from a khaki dun to a dark brown and almost black. For everything concerning them, and the hunting of them, Peacock (20) should be seen. Bison bulls are, as we all know, huge animals of enormous strength which attain a height of over nineteen hands and a weight of more than 2,000 lb., yet these great animals fall victims to the tiger. We saw in the sanctuary the carcase of a recently slain grand old bull bison with rugged horns. He had been done to death by a large tiger which had hamstrung the noble beast by slashing the hind legs with his claws. It was seemingly useless destruction, for only a portion of the tail had been eaten.

One should make as early a start as possible; although when the day is cloudy and a strong breeze blowing animals may be seen at almost any hour of the day. Sambar and hog-deer are in considerable numbers, but it is the bison and *saing* which form the chief attraction in the more open places. The sambar are shy, and it is mostly by chance that a photograph is obtained when stalking time is somewhat limited. The hog-deer are more easy to stalk, being frequently found in the grassy hollows, where there are bushes and clumps of high reeds. But to get really good pictures of the deer it would be better to watch in a 'hide' over a pool of water during the hot hours of the day. It was on the hog-deer ground that the Game Warden showed the place where he was standing when a tiger, crossing at a right angle fifty yards away, suddenly obtained the scent of the hated human and instantly, without looking for the cause, turned left and went away at speed. That is a clear instance that a tiger has more scenting power than many sportsmen realize.

The Manaw Salt-lick

There are two 'licks', much frequented by animals, at which there are machans in large trees. There, if one is fortunate, bison, *saing* sambar, hog-deer, and smaller animals and birds may be seen amid their natural surroundings, all unaware of the watching eyes and clicking cameras. It was when we were approaching the Manaw 'lick' at about half-past eight that the keen eye of the Warden detected movement ahead. Down we all sat. The cameraman—as the soon-to-be-expert possessor of three instruments—telescopic, movie, and stereoscopic, may be designated—had already begun to get his bags of tricks into working order in anticipation of work at the lick: so by the time the bull *saing* had got to within about a hundred yards, almost all movement had ceased. But the wary eyes had detected some movements among our party. The grand beast stopped and stared, the while we examined him through our field glasses. Wandering through the forests in which he had been so long unmolested he had not that fear of man which, in other surroundings, would have caused him to clear out on the first suspicion of danger.

Slowly he came on, and several times he stopped to have another look. His great depth from the withers to the girth was very noticeable, and his muzzle had the appearance of being circled by a white ring. He was grizzled between the horns which curved upwards and inwards, being about twenty-six inches in length. His white stockings, white from above the knee downwards, as are those of the bison, were conspicuous. The outer aspect of the upper part of his forelegs was dark, tending towards black, and his general colouring rather dark khaki. A grand beast indeed is a bull *saing* in the prime of his life.

Much photographed he was during those long minutes when he stood at gaze or slowly paced along. The humble effort of the Kodak is before you (plate). He presented the appearance of a prize Hereford bull. Suddenly he got our wind. Quick and active as a deer he turned and galloped away his white buttocks flashing among the trees.

Bison and Saing

On several occasions we observed *saing* at close quarters in the more open country. One herd that we stalked and photographed consisted of twenty animals: a fine herd bull, two threequarter grown ones, and a two-year old; the others were cows and calves of various ages. Lovely groups the animals made as they browsed about on the open downland, some of them lying close to one another in placid cattle-like content.

To approach this herd we had to disturb a sentinel cow. Very alert she was, and after being photographed by the cameraman got our wind as we advanced under cover of a fold in the ground and made off with a snort of alarm to join the herd. It was curious that her companions did not take alarm: perhaps it was not *that* kind of snort! They merely went on as before grazing and lying down and moving slowly about. It was evident they trusted more to their noses than their eyes; but when hunting these animals early in that year in the dry zone of lower Burma the writer found their eyes to be almost as good as their noses. The cows of the Magwe country were a rich chestnut while those at Pidoung were of a light dun colour.

The bison were more easy of approach than the *saing*. We made a very successful stalk of thirty-seven animals. Just as the stalk was about to commence, a fine bull, probably the same beast we had chanced upon and disturbed twenty minutes previously, paced slowly across our front to join the grazing animals.

This was the cameraman's first essay at animal photography and he obtained good results with all three cameras. So you can imagine the opportunity we had. The Kodak was pretty successful, as you see; and when that old cow spied the bold amateur photographer rudely taking pictures of her she merely snorted and advanced for a closer view, while the intruder crept quickly away to avoid giving further alarm. It was after that, when the cameraman returned to take movie pictures, that he found the herd in the same place and also obtained a 'shot' at a herd of *saing* which emerged from a nearby strip of forest. Fortunate cameraman! This was his first sight of those animals and his first effort at animal photography. Many more exciting stalks and good pictures will reward his future efforts at Pidoung.

TIGERS AND BEARS

On all the game trails we saw numerous 'scratchings' of tiger, also some fresh tracks. Along a path through a thick belt of jungle —the 'Tiger Walk' we called it—were scratchings innumerable, and many of the trees had marks of claws on them. On the trunk of one large tree was the unusual sight of both tiger and bear clawing, the latter ascending high up the trunk where could be seen hanging under a branch the wild bees' comb which had attracted his sense of smell, for he has a keen nose for such a delicacy as honey.

The tigers destroy much game, and steps are being taken to reduce their number. Already the stock of hog-deer is largely diminished, and this extensive area of forest could support many more animals than are in it; but everything must have a beginning and the sanctuary is but a few years established.

Near the Manaw lick several trees had in them platforms made of branches broken off by black bears—the Himalayan Bear (*Selenaroctos thibetanus*)—during the previous rainy season. A photograph taken showed how one side of a tree had been stripped of its branches. This 'nest' was quite a large one, as on the ground are a number of branches since blown down by the high winds. The number of this species of bear in the sanctuary is estimated as sixteen.

ELEPHANTS

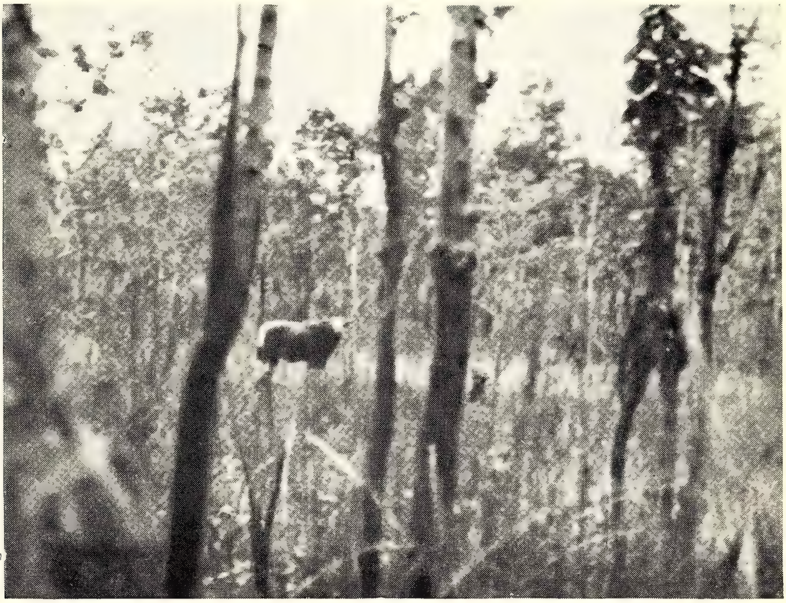
The elephants, of which there are about 140 in the sanctuary, stay mostly in the evergreen forest, so are not often seen. No doubt anyone wishing to take pictures of these beasts could manage to do so as there are sure to be suitable glades, and 'salt licks' also. There would have to be a considerable stock of patience and ample time would also be necessary.

As we were unable to obtain photographs of wild elephants we had to be content with the tame ones which bathed in a pool for our special benefit. The surroundings are perfectly natural. One small tusker was without an attendant, and seemed highly pleased at his second bath that day, as he remained mostly submerged, now and again only the tip of his trunk appearing above the surface to take air to his lungs.

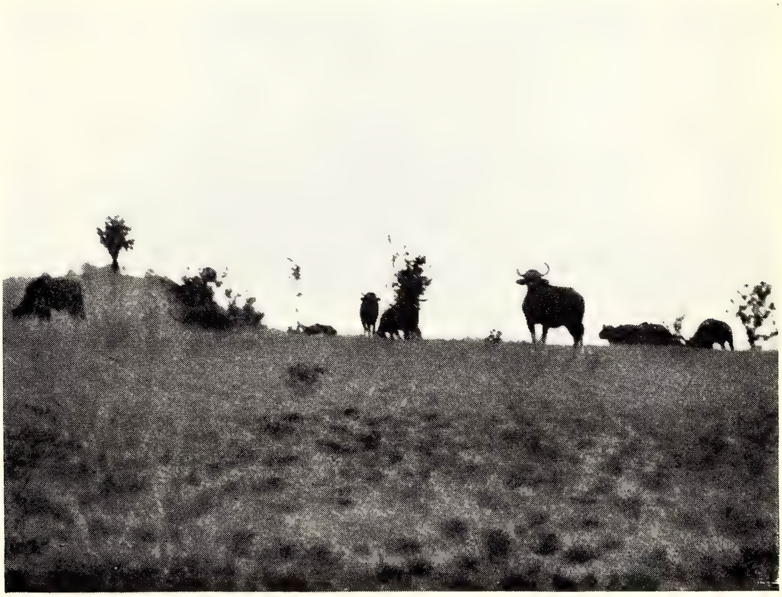
BIRDS AND SNAKES

The sanctuary can show birds of many species. The harsh call of the Chinese Francolin is often heard, and the bird occasionally flushed as one wanders about in the early morning. The Burmese Peafowl is both seen and heard, and it is noticed that the call is not quite the same as that of the Indian peacock. Among the several kinds of quail is seen the tiny Button Quail of which Burma has two species. The Peacock Pheasant lives amongst the evergreen; Whistling Teal and other wildfowl are on the quiet pools of many a stream winding through the dense forests. From all the thickets comes the call of the Red Junglefowl.

The Green Imperial Pigeon is seen. One of these fine birds flew off the scanty platform of twigs which satisfies the species as a

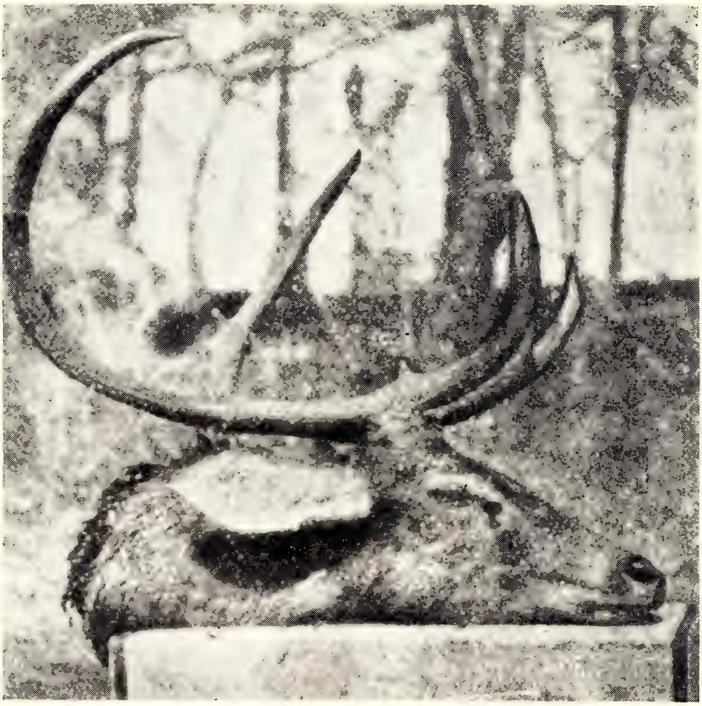


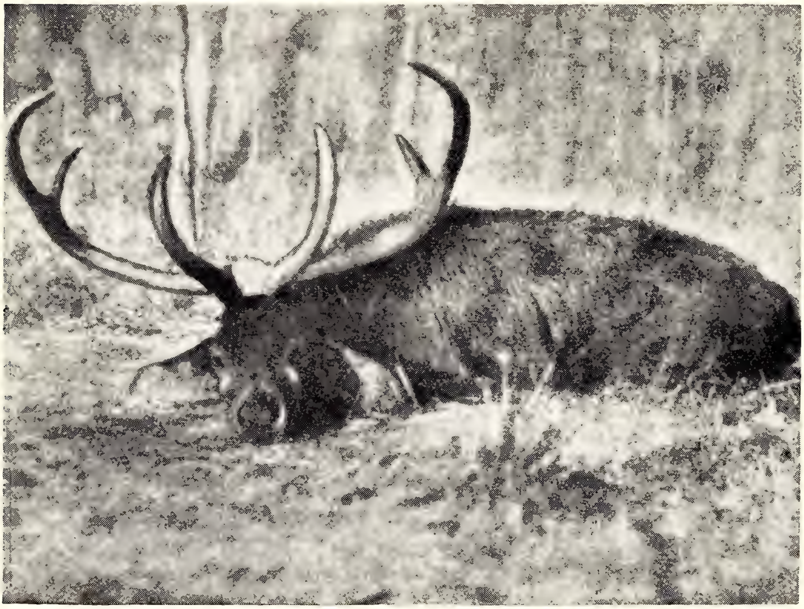
Bull Tsaing or Banteng (*Bibos banteng*)



Photos *Author*

A herd of Gaur (*Bibos gaurus*)





Photos *Col. C. H. Stockley*

The Brow-antlered Deer or Thamin (*Panolia eldi*) nest, and looking up we could see one of her eggs through the interstices of the flimsy structure. A very beautiful bird, the Burmese Red-billed Blue Magpie, was also disturbed off her nest by the side of 'Tiger Walk'.

Everywhere in the jungles of Burma the nest of a species of ant is conspicuous in the tress. It is a curious round, or oblong, affair looking like a black cellular *papier-mache* football. Some of them are much larger than that. They are seen in parts of India also. They are built in the fork of branches, or just around a stem, and in substance are very tough, for in spite of their size they are extremely light and withstand much rough usage. In many of these nests is seen the round hole indicating that the Siam Rufous Woodpecker is, or was, nesting there. It seems that this species always nests in these structures, cutting a tunnel in the usual woodpecker fashion to the centre and there laying the eggs. A live nest is always chosen so that the bird and its brood has food ready to hand, a very excellent board and lodging arrangement for the woodpeckers. What the ants think of it we do not know! A photograph of a typical nest was taken.

One morning we flushed a pipit from her nest in the deep impress made by a *saing's* hoof when the ground was soft. The bird had chosen wisely. In the morning some of the sun's rays would warm the nest which would later on be in the shade. There were three eggs, one of them much lighter than the other two, so perhaps some parasitic cuckoo had also viewed this little nest out in the open plain.

A snake of brilliant hues was killed on a path near the camp. The main colour was coral red, and when tapped on the back with a stick it formed a white corkscrew of the underpart and end of its tail. No doubt this habit is a means of protection, as it was repeated every time the reptile was touched. The snake was apparently McClelland's Coral Snake introduced to scientific notice by Reinhardt in 1844 and named by him in honour of Mr. J. McClelland, a member of the Indian Forest Department of that period. (Wall, *J.B.H.N.S.,* Vol. 25, p. 628.)

Pythons are met with in the evergreen—how is it that we have no recorded instance of a human being having been swallowed by a python in India[1]?—and the dreaded hamadryad is not at all rare, so we were told. In the pools are large water monitors, some of them nearly six feet in length. One which was recently killed by the Game Warden had consumed no less than 41 frogs for his breakfast!

We left the camp, which was about five miles from the railway station after four delightful days. In early May the more open parts of the jungle are scented by the yellow blossom of a species of small tree (*Wendlandia tinctoria*) and amongst the undergrowth are several kinds of conspicuous creamy-white flowers. The foliage of trees has assumed that more vivid green which is a presage of the coming rainy season, so all the birds are joyfully singing and twittering among the leaves.

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[1] Perhaps they don't!—Eds

From the high ground above the Forest Rest House we take our farewell view of the comparatively level country over which we have been wandering in search of the wild life we had come to see, while in the distance are the evergreen hills, the impregnable retreat of the animals from the all destroying hand of man. Would that there could be more inviolate game sanctuaries maintained through the will of the people to protect the larger animals of Eastern countries; for in these days of destruction there is much need for all peoples and all nations to be reminded how valuable but irreplaceable are the fast vanishing wild animals which it is an inherited duty to maintain for posterity.

Brow-antlered Deer

There were no *Thamin* in the Pidoung Sanctuary; perhaps they were introduced later, and before 1942? In any case none will have there survived.

In 1930 it was well recognized that unless adequately protected in one or more sanctuaries the Burmese race of *thamin* would become extinct within quite a few years. The fate of the race—*Panolia eldi platyceros* of countries further east—there were, for instance, many of these deer in parts of Indo-China in 1947—can be imagined.

Pocock designates the Burmese race of this deer as *Panolia eldi thamin* Thomas, while he considers the Manipur race the nominate *Panolia eldi eldi* McClelland.

During the 1914 War the thamin in Woburn Abbey park which had been imported by the Duke of Bedford unfortunately died out; so there are none in England now (1950).

Early in 1949 the present writer put forward through the Society a concrete suggestion for the importation of the *thamin* deer of Burma into Assam. Nothing came of that.

On the 9th November 1949 it was in the Wireless News that the Burma-Assam Road via Manipur would be in use by the middle of February 1950, so a renewal of the suggestion was made and copies of the correspondence sent to the Department of Scientific Research, New Delhi, on the 30th January 1950. The suggestion was passed to the Government of Assam and also brought to the notice of the International Union for the Protection of Nature, Brussels. Up to time of writing, December 1950, no positive action has been taken anywhere. Maybe the Governments of India and Assam are saying that the Burma race of this deer need not be 'saved' since the species exists in Manipur.

It would seem, however, that the Manipur race is also on the very verge of extinction! It is evident that, unless the authorities and departments concerned get speedily busy, nothing will be effected, and these beautiful deer will vanish from both India (Manipur) and Burma—and the world. It is indeed a sad reflection that when the writer was in Burma in 1891, *thamin* were in their thousands, and are now close to vanishing point.

'Where there is a Will there is a Way' is a good old saying; and another which is apposite to the situation is 'tempus fugit' for, as time goes on, the surmountable difficulties will grow worse and not better, as we can all very well see for ourselves. Some will be saying that the saving from extinction of a few deer is a very small matter in these tremendous times. But is it so small a matter that a species should be negligibly allowed to vanish from creation?

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ON THE HYDRO-BIOLOGICAL DATA COLLECTED ON THE WADGE BANK EARLY IN 1949.*

BY

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AND

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INTRODUCTION

In 1907 Hornell, when he was attached to the Ceylon Company of Pearl Fisheries, Ltd., arranged for a trial cruise to areas of comparatively shallow water, within 100 fathom line off Cape Comorin, with a view to locating trawling grounds, if any, aboard the S. T. 'Violet', under the skipper Captain Gibb. During this cruise he struck a trawling ground lying to east, south and west of Cape Comorin within the 100 fm. line, where dredging beyond the 17 fm. line indicated the presence of 'fine grey sand' free from any obstructions to fishing. Hornell reported this area rich in fish and so extensive as to offer good fishing for an indefinite period to a large fleet of steam trawlers of full power and size. This bank is known as 'Wadge Bank' and it extends to a distance of more than 50 miles off shore and covers an area of more than 4,000 sq. miles. The bank is exposed to the S.W. and N.E. Monsoon and hence fishing operations are greatly influenced by the monsoon; during certain months of the year fishing will be practically impossible even by modern vessels due to the strong current prevailing at the time. The Wadge Bank has been explored by the Madras and Ceylon Governments in the succeeding years on a few occasions; the Madras Government worked the trawler S T. 'Goschen' between 1927 and '29. Experimental trawling was conducted by the Ceylon Government in 1913–14 and from 1919 in 'Violet' and 'Lilla'. In 1945 the Department of Fisheries in Ceylon commenced commercial trawling with S.T. 'Raglan Castle'.

In February 1949, the Deep Sea Fishing unit of the Madras Fisheries planned to explore the Wadge Bank areas from the Indian side to determine the economic value of the operations by a small fleet of vessels including the departmental vessels, 'Lady Nicholson', M.F.V. 'Gouhar Khaleeli' and M.F.V. 'Tuticorin'.

The fishing operations commenced on February 2, 1949, and ended on April 8, 1949. As the vessels had to return after a day's fishing to dispose of the catch in fresh condition, fishing was possible once in three days, subject to favourable weather conditions. Under changing conditions of weather, fishing was possible that year only on three days in February and on six days in March 1949. The grounds fished were more than 30 miles off and sometimes 60 miles off the coast. The fishing gear used were ordinary hand lines with four to five hooks attached to each line.

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* With the kind permission of the Director of Fisheries, Madras.

The work was purely of an exploratory nature, to determine the efficiency of line fishing in those areas. Incidentally, opportunity was seized to collect certain hydro-biological data during the few weeks of operations.

ACKNOWLEDGEMENT

Our thanks are due to Messrs. A. I. George, Assistant Director of Fisheries, and Tahar Shariff, Inspector of Fisheries, and the crew of the vessels for the assistance given in the collection of data and in the analyses of the catches.

PHYSIOGRAPHY

From Manapad to Cape Comorin there is a foul shore composed of coral reef and rock extending from the beach to 9 fm. contour. A similar inshore belt from Cape Comorin to Muttam point and even as far as Trivandrum is of fine clean sand, free from obstruction. Towards Trivandrum this sandy belt seems to extend beyond 9 fm. up to 27 fms.

South-south-east of Manapad beyond the 20 fm. line, roughly at a distance of 25–30 miles from the shore, good trawling ground with fine coarse sand, free from obstruction, is found extending to 100 fm. line. This belt of good fishing ground is quite narrow but widens out towards the west and south-west. South of Cape Comorin the belt stretches for about 35 miles. South, south-west and west of Cape Comorin, the belt reaches its maximum width of nearly 50 miles. West of Muttam, it narrows again to about 35 miles. The whole of this belt is composed of sand and dark agglutinated sand. Further north, along this belt, broken masses of dead loose coral were met with though the ground is trawlable. Fine ground, however, stretches, in a narrow belt well within the 50 fm. line, west and north-west of Muttam. South-west of Cape Comorin at a distance of about 25 miles, there is a huge cluster of submerged rocks rising to a height of 5 fm. to 33 fms. above the surrounding sea bottom. (*vide* the Admiralty Chart). Though trawling can be done **to within** the limits of this rocky patch, no trawling is possible over it. The depths range from 45 to 65 fms.

MATERIALS AND METHODS

The motor schooner 'Lady Nicholson' and motor fishing vessel 'Gouhar Khaleeli' were engaged in fishery survey along with three Tuticorin type of canoes. Thirty fishermen and the crew of the vessels were engaged in fishing at one time or another. The two power vessels reached the fishing ground where they served as mother vessels, when the canoes were engaged in fishing with hand lines. The fish caught were measured, weighed and examined for sex, sexual maturity and stomach contents. The position of the ground was fixed by compass bearings. The water sample was collected from a depth of ½ metre below the surface by a canvas bucket and from the bottom by a water sample bottle. The temperature was recorded in °C and the specific gravity was recorded by Aerometer (Sikes Hydrometer).

HYDROGRAPHY

The hydrographical data recorded were only the temperature and specific gravity of sea water both on the surface and at the bottom of

TABLE I

Hydrographical data collected at Wadge Bank

Station	Position	Date and Time	Temperature °C.		Sp. gravity		Current		Nature of bottom	Depth
			Surface	Bottom	Surface	Bottom	Surface	Bottom		
Wadge Bank S. 45°E. 55 miles from Punjal perumanal.	7°31′ 2″N. 77°55′ 8″E.	4–3–'49								
		8 a.m.	25·1°	27·6°	1·025	1·026	NW—SE	...	Rock with sand	45 fm
		12 noon	26·0°	27·2°	1·025	1·026	NW—SE	...		,,
		4 p.m.	27·0°	26·6°	1·025	1·026	NW—SE	...		,,
Wadge Bank S. 45°E. 20 miles. S. 40° E. 38 miles from Leepuram.	7°30′ 45″N. 77°46′ 45″E.	14–3–'49								
		12 noon	26·2°	26·8°	1·025	1·026	NE—SW	...	Rocky	49 fm
		4 p.m.	27·1°	26·4°	1·024	1·026	NE—SW	...	Rocky	,,
Wadge Bank S. 45°E. 50 miles from Leepuram.	7°28′ 5″N. 77°40′ 50″E.	16–3–'49								
		12 noon	26·0°	26·2°	1·024	1·027	NW—SE	...	Rocky	55 fm
		4 p.m.	27·3°	26·0°	1·026	1·027	NW—SE	...	Rocky	,,
Wadge Bank S. 20° E. 55 miles from Leepuram.	7°24′ 55″N. 77°31′ 22″E.	18–3–'4								
		8 a.m.	25·0°	26·0°	1·025	1·026	NE—SW	...	Rock with sand	65 fm
		12 noon	26·5°	26·2°	1·025	1.026	NE—SW	...	...	,,
		4 p.m.	27·4°	26·0°	1·024	1·025	NE—SW	...	...	,,

S. No.	
1	2
	..
2	5
	..
3	3
	..
4	5
	2
5	5
	..
6	2
	..
7	7
	..
8	4
9	..

TABLE II

Details of catches of fishes on the Wadge Bank: Species, their numbers, size & weight

S. No.	Date	Depth	Nature of bottom	Condition of sea	*Lutjanus malabaricus* (Bl. Schr.)			*Aprion typus* (Blkr.)			*Lethrinus lutjanus* (Lac)			*Epinephelus tauvina* (Forsk.)			*E. miniatus* (Forsk.)			*E. bleekeri* (Vaill. & Bocourt)			*E. undulosus* (Q. G.)			Sharks			Total weight of all fish	No. of hand-lines in operation	No. of hours of fishing	Remarks
					No.	Size range	Wt. in lb.	No.	Size range	Wt. in lb.	No.	Size range	Wt. in lb.	No.	Size range	Wt in lb.	No.	Size range	Wt. in lb.	No.	Size range	Wt. in lb.	No.	Size range	Wt. in lb.	No.	Size range	Wt. in lb.				
						Cms.			Cms.			Cms.			Cms.			Cms.			Cms.			Cms.			Cms.					
1	21-2-49 a.	40-45 fm.	Rocky	Calm	29	30-60	151	2	30-90	8	2	30-60	8	90	30-120	748	5	30-40	39	23	30-90	110	14	30-90	116	1		110	1683	25 H.L. — 3 luggm.	9 hours (9 a.m.—6 p.m.)	(*a*) from luggers.
	b.	,,	,,	Rough	13	,,	68	2	...	14	2	...	10	14	,,	118	...	...	...	...	...	...	4	...	34					2 H.L.	do.	(*b*) from M.F.V.
2	23-2-49 a.	40 fm.	,,	,,	17	30-80	132	15	20-90	76	...	...	...	120	,,	942	17	15-30	40	50	20-60	250	7	20-60	40				1868	25 H.L. 3	do.	
	b.	,,	,,	,,	2	...	14	2	25	6	...	...	..	22	30-90	145	4	20-30	6	...	...	...	...	...	...					3 H.L.	do.	
3	25-2-49 a.	50 fm.	,,	,,	37	30-90	244	...	...	...	...	...	...	154	,,	1315	...	...	...	33	30-60	184	...	...	...				2599	25 H.L. 3	3 hours (1-4 p.m.)	
	b.	,,	,,	,,	...	...	...	...	...	...	...	...	...	72	,,	507	...	...	...	...	...	...	...	...	...					4 H.L.	do.	
4	4-3-49 a.	50 fm.	,,	Calm	54	...	338	9	...	64	...	...	...	374	...	3010	12	...	40	54	...	274	7	...	43				4794	26 H.L. 3	11 hours (6-5 p.m.)	
	b.	,,	,,	,,	38	...	264	4	...	34	...	...	...	59	...	492	...	...	...	20	...	112	3	...	30					3 H.L.	do.	
5	14 3-49 a.	49 fm.	,,	,,	16	48-63	101	8	45-75	48	2	38-63	14	86	40-68	650	18	33-45	67	50	35-50	256	7	55-72	59				1340	30 H.L. 4	do.	
	b.	,,	,,	,,	...	...	...	...	...	...	...	...	...	25	40-50	125	...	...	...	...	...	...	...	...	...					3 H.L.	do.	
6	16-3-49 a.	49 fm.	,,	,,	12	48-65	84	...	...	...	...	...	...	44	40-85	334	8	25-35	28	27	35-50	124	...	...	...				733	30 H.L. 4	8 hours (9-5 p.m.)	
	b.	55 fm.	,,	,,	...	...	...	10	45-50	60	...	...	...	8	45-65	64	...	...	...	...	...	...	...	...	...					4 H.L.	do.	
7	18-3-49 a.	65 fm.	,,	,,	...	...	...	63	48-72	546	...	...	...	77	65	604	6	30-45	22	76	35-54	352	...	...	...				2496	30 H.L. 4	do.	
	b.	,,	,,	,,	29	40-55	184	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...					4 H.L.	do.	
8	23-3-49	65 fm.	,,	,,	...	...	...	51	48-80	458	...	...	...	150	45-75	1005	...	...	...	49	35-50	145	...	...	...	2	165-180	168	2185	30 H.L. 6	do.	
9	25-3-49	65 fm.	,,	,,	20	48-50	126	137	48-80	744	...	...	...	99	45-72	598	...	...	...	...	...	...	...	...	...				1614	30 H.L. 6	do.	

the sea. These were registered at 8 a.m., 12 noon and 4 p.m. Only on 4 days, viz., 4th, 14th, 16th and 18th March 1949, was it possible to record the data. On other days the rough seas and rolling of the vessels prevented collection of samples, with the available equipment. The surface temperatures ranged from 25·0° C at 8 a.m. to 27·4° C at 4 p.m. and bottom temperature from 26·0° C at 4 p.m. to 27·6° C at 8 a.m. Temperature was lower at the surface in the mornings and then gradually increased and was higher than the temperature at the bottom as the day advanced. Specific gravity of sea water ranged between 1·024 and 1·026 at the surface and between 1·025 and 1·027 at the bottom. It was always higher in bottom samples than in the surface samples. The details are given in Table I.

FISHES

Details of catches of different commercially important varieties of fish on the bank during the days under review, are presented in Table II.

TABLE III

Details of total catches of each genus on the Wadge Bank

Date	*Epinephelus* spp.	*Lutjanus* spp.	*Aprion pristipoma*	Total weight of all fish
	Lb.	Lb.	Lb.	Lb.
21—2—49	1,165	219	22	1,683
23—2—49	1,477	146	82	1,868
25—2—49	2,006	244	...	2,599
4—3—49	4,075	602	98	4,794
14—3—49	1,157	101	48	1,340
16—3—49	550	84	60	733
18—3—49	1,113	184	546	2,496
23—3—49	1,150	...	458	2,185
25—3—49	598	126	744	1,614
Total ...	13,291	1,706	2,058	19,312

The catches comprised mostly of sea bass, *Epinephelus* spp. and Snappers, *Lutjanus* spp. and *Aprion* (*Pristipomoides*) *typus* (Blkr.). There were a few sharks and sea breams. The genus *Epinephelus* was represented by *E. tauvina* (Forsk.), *E. miniatus* (Forsk.), *E. bleekeri* (Vaill. and Bocourt) and *E. undulosus* (Q.G.). The only species of *Lutjanus* common in the catches was *L. malabaricus* (Bl. Schnr.). *E. tauvina* (Forsk.) was predominant, accounting for a little over half of the total catch. They ranged in size between 30 cms. and 120 cms. They were immature. The body weights of a 50 cm. male and female were 3·7 lb. and 2·5 lb. respectively and those of a 62·5 cm. male and a female, 8·5 lb. and 7·5 lb. respectively. They had fed mostly on other fish. *E. bleekeri* (Vaill. and Bocourt) was next in importance and ranged in length between 30 cms. and 90 cms. These were immature and had fed on other small fish. The other two species of *Epinephelus* were poorly represented.

The fish *Aprion typus* (Blkr.) was next only to *E. tauvina* and the range in length of these species was between 20 cms. and 90 cms. The gonads were not ripe and they had consumed only fish.

Lutjanus malabaricus (Bl. Schnr.) ranked fourth in importance in the catches and it ranged in length from 30 cms. to 90 cms. The gonads were not ripe. All these species had in their stomach small trigger fish, *Balistes* spp.

Of the total quantity of 19,312 lb. of fish landed on nine days by hand lines, 13,291 lb. belonged to *Epinephelus* spp.; and *E. tauvina* (Forsk.) alone accounted for 10,657 lb. On the three days of fishing in February 6,150 lb. were landed and on 6 fishing days in March, 13,162 lb. were landed. Based on the number of hours of fishing and the number of hand lines employed, it works out to 33·2 lb. of fish per hour per line. Expert fishermen land four to five fish at a time, otherwise it may not be worth the trouble of landing one fish at a time and to haul up the line for 100 metres !

DISCUSSION

The range of variation in temperature of surface layers of the sea on the Wadge Bank has been between 0·9° C to 2·4° C; and that of the temperature of the bottom layer between 0·2° C to 1° C. There does not seem to be any direct relationship of the trend of temperature variation of the surface layer with that of bottom layer. But in the diurnal variation of temperature at the bottom layer, it is noticed that the maximum range of 1° C was observed at a depth of 90 metres and the variation has been 0·4° C at a depth of 98 metres, 0·20° C at 110 metres and 130 metres. This indicates that the range of diurnal variation of temperature gets reduced as the depth increases in this region. Presenting the table of temperature at different depths in the Gulf of Manaar in January 1921, Sewell (1929) recorded that 'in five instances out of eight the surface temperature is lower than the temperature at a depth of 50 metres and again this occurs at any time of the day, so that it does not depend on the greater cooling of the surface water during the night' and in these two southernmost stations near Wadge Bank, they are so. Sewell further indicated from the data of temperature and salinity recorded in March and April 1920 in the southern regions of the Gulf of Manaar from surface to a depth of 50 metres that once late in April the temperature of surface water was less than that at a depth of 50 metres and also that 'during the winter months surface water of Indian Seas, or at any rate of certain areas, may be colder than that lying at a depth of some 20–25 metres and, furthermore, that this condition is specially likely to be present during the night and early morning hours'. Similar trend of variation in temperature in the surface and bottom layers of the four stations in the Wadge Bank in the month of March 1949 was observed by us; the surface temperature being less in the morning than that at the bottom at depths more than 90 metres and higher at the surface than at the bottom in the afternoon at 4 p.m.

Sewell (1929 p. 309–311) observed that in the latter part of April and May, and in October and November, the surface waters might be more saline than that at a lower depth and that in the north-east monsoon months of January and February the surface water would be less saline than that below. He had also indicated that the variations might be caused by the force of wind and the prevailing temperature of the sea water. In March 1949, it was not possible to estimate the salinity. If specific gravity could be taken as indication of salinity, it could be said that the specific gravity was less at the surface than at the bottom layers.

Hornell (1916) found the Indian grounds 'greatly superior in extent and richness' to those off Ceylon and observed that the Wadge Bank 'is generally much richer in the daily quantity of fish catchable by each trawler and is so extensive in area as to offer good fishing for an indefinite period to a large fleet of steam trawlers of full power and size. This ground comprises the whole of that wide submarine plateau within the 100 fm. line which lies off Cape Comorin on the western, southern and eastern aspects . . . On the Cape Comorin grounds so long as the fishing was carried on outside of the 17 fm. line plenty of fish were everywhere met with . . . The trawl skipper of the 'Violet' returned to port enthusiastic over the trawl potentialities of the Cape Comorin Bank of soundings both in regard to the large quantities of good quality fish to be had there and to the clean and unobstructed nature of the bottom.'

Sundara Raj (1931) while reporting on the survey of deep sea fishing grounds by S. T. 'Lady Goschen' observed that 'the noteworthy changes since 1907 in this area are (i) that good trawl ground with sand bottom was not met with upto about 20 fathoms south and south-west of Manapad and Cape Comorin; (ii) the large rays (Plough fish and Sharks) were not found off Manapad or Cape Comorin, but only on the western margin of the plateau in about 40 fm.' During the trawling experiments of the 'Lady Goschen' in 1927–28 and 1928–29 trawling on the Wadge Bank was carried on in depths less than 50 fms. excepting on one occasion, when the trawl was shot at a depth of 60 fms. During these trials the rate of catch per hour worked out to 140 lb. in 1927–28 and 200 lb. in 1928–29, as indicated below :—

TABLE IV

Rate of catches of fish by S. T. 'Lady Goschen' (1927–29) *in Wadge Bank*

Year.	No. of days fished	No. of hauls and hours fished		Total catches in lb.	Catches of *Epinephelus* spp. in lb.	*Lutjanus* spp. in lb.	*Lethrinus* spp. in lb.	Rate of catch per hour	Depth fished
		Hauls	Hours						
1927–28	8	19	66½	9296 lb.				140 lb.	22–47 fms.
1928–29	11	22	79¼	15904 lb.	2032 lb.	2114 lb.	2106 lb.	200 lb.	22–37 fms.

Malpas (1926) referring to the Wadge Bank indicated that 'the bank is fishable upto 100 fathom overall.' In 'Lilla', no information was available for trawling on the banks in depth exceeding 45 fm. The average rates of catch per hour by 'Lilla' on the Wadge Bank in depths between 11–20 fm. and between 21–45 fm. were 157·7 lb. and 238·4 lb. respectively with a large proportion of the best class of edible fish. For the above two vessels, the data on average catch per day's absence are not available; but for the vessels which operated on Wadge Bank from Ceylon after 1928 the details of average catch per day's absence are taken from the report 'Commercial Trawling in Ceylon Seas' by Amirthalingam and De Zylva and they are presented below:—

TABLE V

Average catch per day's absence on Wadge Bank

Names of the Power Vessels used for trawling	Average No. of days absent annually (in years)	Average catch per day's absence (hundreds of lb.)	Average annual catches (Hundreds of lb.)
'Bulbul' ...	175·5 days 1928 to 1935	42·07	7790·04
'Tongkol' ...	58·5 days 1928 to 1929	28·52	1806·58
'Raglan Castle' ...	71 days 1945 to 1947	55·11	4025·82
'Aringa' ...	154 days 1947	64·07	9867·27

Details of maximum depths at which trawls were tried from the above four vessels and the range of depths where catches were heavy are not available. It has been successively proved that the availability of excellent fishing on the Wadge Bank and the catches on this bank have compared very favourably with the productivity of the trawling grounds elsewhere. This bank is 'beyond the reach of the type of craft now used by local fishermen' (Amirthalingam and De Zylva, 1948).

South-west of Cape Comorin at a distance of about 25 miles, the huge cluster of submerged rocks rising to a height of 30 to over 200 ft. above the surrounding sea bottom termed 'Wadge Bank' in the Admiralty Chart, though not suitable for trawling, is very good for hand lines. As such the methods to be adopted for the development of fishing in the Wadge Bank beyond the range of the existing craft in the Indian waters, will be (1) Hand lines and (2) Trawling. Hand lines have to be operated like the dories working off a mother vessel or from a fast power boat with a special hold to work in the off-shore regions off Cape Comorin. The fishery survey early in 1949 was directed mainly towards the operation of hand lines to find out the productivity of these rocky patches on the Wadge Bank where trawling and long lining at the bottom were not feasible. It will be seen from the details of catches, that the hand lines were operated in beds deeper than 40 fm. and the landings had been at the rate of 33·2 lb. per line per hour.

TABLE VI

Details of Catches based on results of S. T. 'Lady Goschen'—(1927–1930)

Banks	Wadge Bank				Manapad Bank				Palk Strait	Point Calimere, Negapatam				Off Calicut			Off Mangalore	
Depth in fms.	10	11–20	21–45	46	10	11–20	21–45	46	10	10	11–20	21–45	46	11–20	21–45	46	11–20	21–45
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
Catch per hour ...		452·3	147·8	115·1		73·7	173·2	65·4	233·8	317·3	161·0	46	660	375	80	51·7	540	194
No. of hours fished ...		3	190	11		20½	45	5	22	6	26¼	78½	16¼	31¼	62	3½	12	9
Suitable depth for fishing ...	11—45 fms.				20—45 fms.				Less than 10 fms.	(less than 20 fms. and above 45 fms.)				11—20 fms.			Less than 40 fms.	
Month fished ...	December—March				November to February				August to November	June to September				November to April			December	
No. of days of fishing ...	60 days				75 days				75 days	60 days				90 days			70 days	

The magnitude of the catches can be appreciated by the landings of 2,599 lb. on 25-2-1949 by 29 handlines in 3 hours and of 4,794 lb. on 4-3-1949 by 29 handlines in 11 hours. Such a rate per unit of effort indicates the richness of these rocky patches on the Banks and the survey definitely proves what John (1948) considered possible—viz., 'that certain regions of the Travancore coast such as the south western corner of the Wadge Bank, 60–75 fathom region off Anjengo and Chandra where the ground is hard and rocky, are rich in ground fishes, such as grey snappers............These fishing grounds are not suitable for trawling and seining. But line fishing is possible.........'

The previous trawling surveys have indicated the richness of the bank for bottom fishes and also that a large section of the bank is suitable for trawling. It will not be out of place here to indicate the catches by the trawlers on the Indian coasts by different vessels and at different depths. These are presented in Table VI, VII and VIII.

TABLE VII

Details of catches on the Wadge Bank 'Lady Goschen' and 'Lilla'

Depth	'Lilla'—Ceylon Government				'Goschen'—Madras Government	
	Gross wt. per hour	1st class edible fish	2nd class edible fish	No. of hours	Gross wt. per hour	No. of hours
10 fms. ...	nil	nil	nil	1 hr.	...	...
11–20 fm. ...	157·7 lbs.	145·3	11·4	20 ,,	452·3	3 hours.
21-45 fm. ...	238·4	200·4	34·6	22 ,,	147·8	190 ,,
46 fm. ...					115·1	11 ,,

TABLE VIII

Details of catches on the Pedro Bank—'Lady Goschen' and 'Lilla'

Depth	Lilla—Ceylon Government				'Goschen' Madras Government	
	Gross wt. per hour	1st Class edible fish	2nd Class edible fish	No. of hours	Gross wt. per hour	No. of hours
	Lb.	Lb.	Lb.		Lb.	
10 fm. ...	70·4	11·8	58·9	10	317·3	6
11– 20 ...	145·6	118·7	23·0	8	161	26¼
21– 45 ...	130·0	115·9	13·3	20½	46	78½
46–100 ...	42·5	39·8	2·0	4	660	16¼

It will be evident from the figures of catches and the total number of hours fished, that Wadge Bank yielded a good rate of catch, viz., 452·3 lb. per hour in depths between 11 and 20 fms. and 147·8 lb. in depths between 21 and 45 fms. The yields in the same depth ranges recorded by S. T. 'Lilla' worked by Ceylon show also a high figure of 157·71 lb. and 238·4 lb. in 11 to 20 fm. and 21 to 45 fm. ranges respectively. On the Pedro Bank, in depths less than 45 fm., the rate of catch per hour by the trawlers was equally good. In the bank off Manapad the depths between 21 and 45 fms. indicate the presence of fairly large quantities of bottom fish. These show the richness of the Wadge Bank and Pedro Bank. Catches by trawlers compare favourably with the catches elsewhere, but trawling has not yet proved commercially feasible owing to certain other difficulties and it is suggested that the introduction of these mechanised craft should be gradual and that specifications of the type and size of the trawler should be suitably modified.

SUMMARY AND RECOMMENDATION

Fishing operations were conducted in the Wadge Bank area during February, March and April of 1949 with the help of the vessels of the Fisheries Department. This opportunity was availed of to obtain certain hydrographical data and biological data on the fishes of the locality. The fish examined included *Epinephelus tauvina* (Forsk.), *E. miniatus* (Forsk.), *E. bleekeri* (Vaill. and Bocourt), *E. undulosus* (Q.G.), *Lutjanus malabaricus* (Bl. Schnr.) and *Aprion typus* (Blkr.) Summary of data on their length, weight, sex, condition of gonads and stomach contents are presented in this paper.

With the available knowledge that the productivity of the Wadge Bank has been proved to be good, it is recommended that fishing with hand lines may be taken up immediately on an organised scale with a fast 45 ft. sea-worthy power vessel to enable the catches to be brought ashore quickly for prompt disposal and marketing. This should encourage the development of line fishing with a mother vessel and small boats for fishing and with adequate facilities either for storage in the mother vessel or speedy transport in other power vessels to the shore at periodic intervals. Simultaneously with this type of fishing further efforts need to be made to make trawling commercially successful by modifying the designs of trawlers to suit local conditions and as may ensure efficient preservation.

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WILD LIFE RESERVES IN INDIA: UTTAR PRADESH

BY

LT.-COL. R. W. BURTON, I.A. (Retd.)

1. The Hailey National Park

The following is contributed by Mr. S. S. Negi, D.F.O., Ramnagar Forest Division, U.P. (December 1949):

'When the article on the Hailey National Park was published in the *Indian Forester* of November 1936, the Park had been in existence only for a little over a year. The wild animals, inside the boundaries of the park were then not notably less shy than those in the forests outside the boundaries.

2. A strict protection of about 15 years, since then, has enormously increased the number of wild life inside the Park and has made them much tamer. It is not unusual to meet a herd of chital, sometimes of up to 100 heads, grazing peacefully by the roadside, while a visitor is passing by in a moving vehicle or on an elephant. The animals lift their heads, without much concern, merely to see what the intruder is like, and then continue grazing as if nothing has happened. They are sometimes somewhat shy of visitors on foot and run off some distance and keep staring from there till the intruder has passed out of sight.

3. The tigers and panthers have also grown considerably carefree. They are often found roaming about in open areas in daytime, and when they come across a man they look at him with curiosity but without any sense of fear. It has sometimes been necessary to shout at a tiger to drive him away from staring at one too interestedly!

4. The animals appear to be conscious of protection inside the boundaries of the Park. It has often been noticed along the boundary of the Park that a herd, on seeing a passer-by, will run across into the sanctuary and look from there with the satisfaction of safety, even though their natural retreat be in the opposite direction.

In connexion with the above is reproduced an account of the Park written in July 1939 by Mr. F. W. Champion the then D.F.O. of the Kalagarh Forest Division.

It may be remarked regarding the hydro-electric dam across the Ramganga River 'which has largely cut off the migrating fish from their spawning areas' that similar harm has been done in other rivers of India, and in some canals. An article on this important subject will be published in the *Journal*.

'This fine National Park, one of the first permanent National Parks as distinct from temporary sanctuaries to be established in the East, owes its inception to Lord Hailey, who, when Governor of the United Provinces in 1934, asked the Forest Department to make proposals for the creation by the legislative authority of a National Park on the lines recommended by the International Wild Life Conference of 1933. Mr. E. A. Smythies, I.F.S., now (1939) Chief Conservator of Forests in the United Provinces, was asked to make definite proposals for a suitable area in the Western Circle and he chose the famous Patli Doon on the borders of the Ramganga River in Kalagarh Forest Division, combined with a portion of hill forest to the south of it, lying partly in Kalagarh and partly in Ramnagar

Divisions. His proposals were accepted and an area of about 125 square miles was constituted as a permanent National Park under the U.P National Parks Act of 1935. This was a great step forward in the preservation of wild life in India and it is to be hoped that, in due course, this beautiful area of hill and dale will develop into a permanent refuge for the disappearing wild animals of this country and a quiet resort for visitors who wish to see the splendid wild creatures of India in an undisturbed and natural state. It must always be remembered, however, that it takes a long time to remove the inborn fear of man exhibited by wild animals and one cannot expect much in the very few years that the Park has been in existence. It took 25 years to tame the animals in the fine Kruger National Park of South Africa, and we must expect much the same sort of thing here, but the chital and sambar are already (1939) beginning to respond to the absence of firearms and will allow a motor car to pass quite close, although they still keep their distance from tame elephants and human beings on foot. The tigers, so far, are much the same as they were before, although they are quite often to be seen at a distance in the day-time. In due course, when a new generation of tigers that have never been hunted grows up, it is more than likely that the tigers will carry on their daily life regardless of the presence of human beings in the way that lions are now to be seen doing in the National Parks of Africa.

The area chosen for the Hailey Park is almost ideal for the purpose, being noted for its beauty and containing as it does almost every type of Himalayan foot-hill forest. Perhaps the finest portion of all is the Patli Doon itself, which consists of a broad flat valley of old river terraces, two or three miles broad and fifteen miles long, covered for the most part by great seas of waving tiger grass, which, after it is burnt in the spring, becomes a green sward of short new grass so beloved of chital and hog deer. Among the grass are patches of forest and scattered specimens of dhak, semal and Bauhinia, with dense patches of shisham bordering the beautiful Ramganga river, which flows through the doon, meandering from side to side and changing its course every year. This area in the spring, with the lovely green of the new leaves of the shisham, the gorgeous scarlet flowers of the flame-of-the-forest and silk cotton trees, the mauve blossoms of the Bauhinia and sandan trees and the lovely pink of the budding kusum, combined with the crystal clear sparkling waters of the Ramganga river, must surely form a scene of beauty that can have few equals anywhere in the world. But the Patli Doon is part only of this chosen spot. At its lower end the hills close in on the river, and between Boksar and Kalagarh there is precipitous and lovely gorge where great slabs of bare sandstone and vertical rock strata alternate with deep-sided damp ravines where ferns, orchids and tropical creepers flourish. Through this striking gorge flows the river sometimes foaming over boulders, sometimes burying itself into great pools of unknown depth and tenanted by huge mahseer and goonch, while on sandbanks and rocks are often to be seen basking in the sun both species of India's inland crocodiles. The gorge terminates very suddenly at Kalagarh, where the last outer rampart of the Himalayas occurs, and the river passes out of the Park into the great flat bhabar tract below. Then again there is another steep gorge at the upper end of the doon, whereas to the south there is a wild and broken tangle of hills, valleys and streams, totally uninhabited by man except for the forest staff and occasional timber contractors' workmen, where one can wander at will in untrodden wildernesses covered with tiger tracks, and where one may meet at any time any of the numerous kinds of animals that inhabit this favoured tract.

The wild animal population of the Hailey Park consists of a great variety of species. There are a few wild elephants, but a good deal of the area is too rough for these huge animals; a very large number of tigers; a few leopards, hyenas and jackals with an occasional wild dog; a fair number of sloth and Himalayan black bears; a very large number of chital, some with fine heads; a lesser number of sambar generally with poor antlers; some magnificent hog deer in the Patli Doon and numerous kakar everywhere; a very occasional serow and a fair number of goral; mongooses, palm-squirrels and flying squirrels, ratels, wild cats and otters. It is hoped in due course to introduce also gond (swamp deer) and a better strain of sambar. There are gharial and mugger in the rivers and a few pythons, hamadryads, cobras and Russell's vipers scattered about the forests. The fishing in the Ramganga river used to be very good indeed, but it has been very seriously upset by the construction of a hydro-electric dam across the Ramganga some 20 miles below the Park which has largely cut off the migratory fish. The river is, however, readjusting itself to the new conditions and quite good mahseer and Indian trout fishing is to be had in the spring and summer months. There are also huge goonch that lurk in the rapids and deep pools, and a good many other species of fish that are not usually caught on rod and line.

The above should give some idea of the type of country and inhabitants of the Hailey Park and it remains to explain how to get there and what arrangements to make for a visit. The Forest Department during the last few years have done a very great deal to make the Park more accessible, and a system of fair weather motor roads has now been constructed making it possible to see most of the Park from a light car skilfully driven, between December and June. The nearest railheads are Kotdwara and Ramnagar and it is also possible to motor from Dehra Dun, Ranikhet, Lansdowne, Haldwani or Naini Tal. The distance from Ramnagar to Sultan, one entrance to the Park, is about 14 miles. From Haldwani to Sultan is about 50 miles and from Dehra Dun to Kalagarh about 90 miles. Permission to enter the Park should be obtained from the D.F.O., Kalagrah Division, Lansdowne, or the D.F.O., Ramnagar Division, Ramnagar, from whom maps of the Park can be obtained. Absolutely no shooting is allowed but daylight photography is permitted and permits to fish in the Ramganga are issued. There are forest rest-houses at Sultan, Gairal, Sarapduli, Dhikala, Boxar, Kalagarh, Paterpani, Gaujpani and Jamnagwar in the Kalagarh Division, and Malani and Bijrani in Ramnagar Division, permits to occupy which, if available, may be obtained from the D.F.O's. concerned. These rest-houses contain essential furniture, but no crockery, lamps or sweepers. They are not always available and visitors who intend making a prolonged stay should bring tents. Food supplies are scarce and visitors must bring a large supply of tinned provisions. No petrol is available except in Ramnagar or Kotdwara. The D.F.O., Kalagarh Division, can sometimes help with a limited supply of milk, vegetables and possibly goats, fowls and eggs. Fish can be caught by the skilful—in the Ramganga river. Visitors are strongly advised to employ one or two dak runners to bring out food and letters from Ramnagar.

The roads in the Park are all unmetalled and are motorable only during fine weather between December and June. Communications are sometimes cut by heavy winter rains in January and February. The climate is fairly good and cool, particularly at night, but a mosquito net should be used.

A limited number of visitors will now be welcome, but a large influx of people is most undesirable until the Park has been in existence sufficiently long for the animals to become tamer and more used to human beings. Communications are being improved year by year and it is to be hoped that at the end of another decade, Northern India will possess a National Park comparable to the fine National Parks of other countries.'

2. The Rajaji Wild Life Sanctuary

Members will be interested in some details of the Kansrau Sanctuary formed in 1940-41 and recently named after the last of the long line of the Governors-General of India. It is situated in the Siwalik Hills, Saharanpur Forest Division of Uttar Pradesh.

The information is extracted from notes contributed by Mr. G. M. Johri, D.F.O., Dehra Dun Forest Division, through the Conservator of Forests, Western Circle, U.P., Naini Tal.

The Sanctuary covers an area of nearly 64,902 acres or 101 square miles and includes some former Shooting Blocks.

The upper parts are very rugged and precipitous, sometimes broken with slopes and gradients of all kinds. The middle slopes are at places moderate to steep, or fairly level to slightly undulating, with a general slope towards the south forming a flat to undulating base in the submontane area along the forest motor road and the Khara-Hardwar cart road.

Rock and soil is mainly sandstone, with loose conglomerate beds in the upper parts. There are about sixteen *raus* (ravines) and numerous feeder nalas and *sōts* (precipitous water courses). Most of these remain dry for the greater part of the year. In fact, water is available in only a few of them till the advent of the hot season when most of them, except in the middle zone, appear to be waterless. In the north east of the Sanctuary water is available all the year round as the Suswa and Song rivers flow on that side. Natural springs are rare.

The Sanctuary is traversed by the Dehra-Saharanpur metalled road through the Mohand Pass down to the Mohand, and a forest motor road runs along the submontane tract from east to west joining Dholkand, Mohand, and Shakumbheri Forest Rest House; while the Khara-Hardwar District Board public road forms the southern border of the Sanctuary.

On the upper Siwalik slopes, the jagged summits of which attain an elevation of 3,000 feet, the forest is stunted and open consisting on the southern side of pines (*Pinus longifolia*) and scattered *Anogeissus* *latifolia, Boswellia serrata, Buchanania latifolia, Odina wodier, Ougenia dalbergioides,* and *Garuga pinnata.* The middle and lower hills are clothed with a better type of forest among which are *A. latifolia, O. wodier, G. pinnata, Bauhinia purpurea, B. malabarica, Diospyros tomentosa, Albizzia lebbek, Acacia catechu, Terminalia belerica, T. tomentosa, Cassia fistula, Ficus religiosa, F. bengalensis, Emblica officinalis, Lagerstroemia parviflora,* and other trees and shrubs of the area.

The strips of forest along the ravine beds and sides consist chiefly of shisham (*Dalbergia sissoo*) and khair (*Acacia catechu*) in the riverain tracts; and sal (*Shorea robusta*), *Terminalia tomentosa, T. belerica, Cedrela toona, Adina cordifolia, Mitragyna parvifolia, Bauhinia purpurea, B. malabarica, Anogeissus latifolia, Kydia calycina, Zizyphus jujuba, Z. xylopyra, Lagerstroemia parviflora, Bombax malabaricum, Sterculia villosa, Albizzia lebbek, Casearia tomentosa, Ficus religiosa, F. bengalensis, F. glomerata, Ougenia dalbergioides, Ehretia laevis, Aegle marmelos, Limonia acidissima, Holoptelea integrifolia, Grewia elastica, Diospyros tomentosa, Holarrhena antidysenterica, Wrightia tomentosa,* on the plateaus of the submontane tracts.

The under-storey consists of *Mallotus philippensis, Zizyphus xylopyra, Holarrhena antidysenterica, Carissa opaca,* in parts with undergrowth of *Helicteres isora, Adhatoda vasica,* and various grasses. The upper and middle hills are fairly covered with *Pollidinium angustifolium, Chrysopogon montanus,* and *Heteropogon contortus* grasses; whereas the strips along ravines are thickly stocked with 'ula' and 'dhub' (*Cynodon dactylon* which is the chief and best of pasture and fodder grasses), *Saccharum munja* etc.

In places along the ravines are fair strips of evergreen forest with such species as *Eugenia jambolana, Machilus gamblei, Phoebe lanceolata, Litsaea polyantha,* etc. The canopy is closer in the area east of the Dehra-Saharanpur metalled road.

Bamboo occurs throughout the region in the middle and upper parts.

WILD LIFE

The area contains all the larger animals of the northern forests of the U.P., viz., Elephant, Sambar, Chital, Barking Deer, Goral, Tiger, Panther, Sloth Bear, and a very few Himalayan Black Bear when the honey season is on. There are also hyenas and wild pig. Of the smaller carnivora there are the Common Jungle Cat, the Leopard Cat, the Common Palm-Civet or Toddy Cat, and perhaps the rare Spotted Linsang or Tiger Civet. The Himalayan Yellow-throated Marten will be seen, and perhaps the Red Flying-squirrel, and of course the ubiquitous Five-striped Palm Squirrel. Wolves and foxes appear to be now absent from the area as they are very seldom seen; wild dogs occur. Hyenas mostly frequent the rocky ravines and may be found singly or in family parties. Porcupines are not uncommon and do damage to young trees. The Indian Pangolin or Scaly Ant-eater also the Ratel or Honey-Badger occur, but are seldom seen. Jackals will be both seen and heard.

In the rivers and deep pools are crocodiles of both species, (Gharial and Mugger) and the Smooth Indian Otter hunts along the rivers, streams, and jungle pools where they exist. Pythons of the Siwaliks grow to more than usual dimensions. Of the poisonous snakes there are cobras, daboias, kraits, saw-scaled vipers, all of which can be deadly to man, and the King Cobra or Hamadryad may perhaps be met with. Besides these is a number of non-poisonous species, and of those of green coloration the Common Green Pit Viper may be mentioned as non-lethal to man but the bite of which may cause severe local effects and constitutional disturbances.

Of the Primates the Common Langur or Hanuman Monkey, and the Rhesus Macaque or Bandar, are common in both the forest area and in the neighbourhood of habitations.

Among ground or small game, are hares, peafowl, red junglefowl, spur fowl, black partridges, and various species of quail. The Kalij pheasant is found in the interior in suitable places.

Part of the *taungya* plantations in Barkala Range in Shambukheri, Sahansra, and Kothri Blocks come within the limits of the Sanctuary and under the new Working Plan such plantations are to be extended along the submontane tracts. These will afford added cover for birds and the smaller animals.

The wild elephant is somewhat rare in the Sanctuary, but sometimes two or three may be seen roaming in suitable environment. One of these is a big tusker, supposed to be the biggest ever seen in Uttar Pradesh, and Mr. F. W. Champion took several photographs of this animal in various situations.

Where tracks disclose the presence of tigers they could be observed in the early mornings or late afternoons in selected places, success being more likely from elephant back. In this way also many other animals of the area and their tracks could be observed, should a riding elephant be available and the necessary permission obtained from the appointed forest official.

Sambar mostly select *Boswellia serrata* on the higher ground for their mid-day rest, lying up under some isolated tree. They travel long distances in search of food, and may be seen in small parties of two or three animals.

The Spotted Deer or Chital is widely distributed in the area being the most gregarious of Indian deer. The herds may include hundreds of individuals and the lovely creatures become very tame in a sanctuary. Being mostly partial to low level ground they are readily observed by the visitor. The record head of 39¼ in. was obtained in Bahraich, but several heads of 39 in. have been shot in the Siwalik forests.

Barking deer will be seen, and also heard calling to one another or giving loud alarm calls on scent or sight of the larger felines. The nimble Goral (wild goats) frequent the rocky ground and steeper places in the middle of the forests, and are usually associated in small parties of 4 to 8 animals. Their principal enemy is the panther.

The sloth bear may perhaps be seen, and an occasional wild boar or a sounder of wild pig will be encountered. There are in the area some hundreds of species of wild birds including several eagles and smaller birds of prey, and vultures. For the camera are many attractive subjects, both scenery and mankind, and the visitor to this Sanctuary is sure of much enjoyment and many pleasing memories.

OBSERVATIONS ON THE EGG-CASES OF SOME OVO-VIVIPAROUS AND VIVIPAROUS ELASMOBRANCHS, WITH A NOTE ON THE FORMATION OF THE ELASMOBRANCH EGG-CASE[1]

BY

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(*With a plate*)

INTRODUCTION

Egg-cases of a number of oviparous Elasmobranchs have been described from time to time, the oblong egg-capsules of skates and rays being known as 'skate barrows,' 'sailors' purses,' 'mermaids' purses,' and 'mermaids' pin-boxes'. As in all the oviparous species known so far, so also in all ovo-viviparous and most of the viviparous species, the egg is protected by an egg-case. But little attention seems to have been paid to the study of the egg-cases of ovo-viviparous and viviparous Elasmobranchs.

Prasad (1945 a, b and 1948) reported certain structural modifications that had been observed in the nidamental glands of Elasmobranchs as oviparity gives place to viviparity. In a recent paper Matthews (1950), while describing the nidamental glands of *Cetorhinus maximus* remarks: 'The structure of the gland in *Cetorhinus* is such as to suggest that its function is solely that of secreting albumen; if any shell is produced it is unlikely to be more than a membranous sac, as in *Acanthias*'. The present work was started with a view to study the probable changes that might result in size, shape and structure of the egg-cases of ovo-viviparous and viviparous Elasmobranchs as oviparity gives place to viviparity and the following is a preliminary report on the observations made on a few ovo-viviparous and viviparous Elasmobranchs of the Madras Coast.

EGG-CASES

The best developed egg-capsules are naturally those of oviparous forms. They vary from the simple horny capsules of many of the common oviparous species to the highly developed egg-capsule of *Heterodontus*, where it is of relatively large size and has the form of an elongated conical capsule with very thick walls, provided with two broad flat flanges twisted spirally around it and two long coiled filaments at the pointed end. Variations in the egg-cases are found even within the same family. Such differences are given by Clark (1922) who has described the egg-capsules of eight species belonging to the family Raiidae. He mentions also that capsules spawned by the same fish show considerable variation in size. In the egg-cases of some of the oviparous species the four corners are drawn out into long tendrils; in some others the four corners may be produced into horns of varying lengths; in some only two corners are produced into long horns, the other two being short, stumpy and strongly hooked; in still others there are numerous delicate filaments on the two side margins of the egg-case. The tendrils, horns and filaments are all considered to be different aids for anchoring the egg-capsule. Of the egg-cases belonging to the different species of oviparous Elasmobranchs, the largest recorded is one hundred and eighty millimeters in length and about one hundred and fifty millimeters in width, the smallest about sixty-three millimeters in length and thirty-seven millimeters in width (Norman, 1947). Among the egg-cases of the various species of the family Scyllidae, Smedley (1926) observed a gradation. He says: 'The members of the family Scyllidae inhabiting Malayasian waters provide examples of three distinct types of egg-cases. 'That of the genus *Scyllium* has the four corners produced to form long tendrils, and it is not until these have become firmly entwined around some fixed object that the egg-case is drawn from the oviduct of the female. *Chiloscyllium indicum* has a band of fine mucilaginous hairs which may form a means of anchorage after the laying of the egg. 'In the case of *Stegostoma* no method of attachment is provided and the egg apparently drifts until the hatching out of the young shark.'

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[1] This investigation was carried out while the author was working in the Madras University Zoological Research Laboratory, but the publication has been delayed owing to his being away on an Overseas Scholarship.

These are typically oviparous forms. The next stage in the gradual transition from oviparity to viviparity is the ovo-viviparous condition. Since in the ovo-viviparous and viviparous forms the egg-case is retained in the uterus the means of anchorage such as tendrils and mucilaginous hairs have been lost. Probably egg-cases such as those of *Stegostoma* indicate the transitional stage through which Elasmobranchs passed gradually from oviparity to ovo-viviparity[1].

The egg-case of *Chiloscyllium griseum,* an oviparous species, found commonly along the Indian Coast, has been described by Aiyar and Nalini (1938) and Nalini (1940).

Of the ovo-viviparous Elasmobranchs that occur along the Madras Coast, the author has examined the egg-cases of *Rhinobatus granulatus, Rhynchobatus djiddensis* and *Pristis cuspidatus*. All these have almost similar egg-cases measuring on an average 250 mm. by 120 mm. Each egg-case is a large bag made up of two lateral halves, enclosing three to five eggs, the number being subject to variation. Photo I shows the egg-case of *R. granulatus* opened to show the eggs in it. The walls of the egg-case are soft, fairly thick, highly elastic and brownish yellow in colour. The two poles of the egg-case show slight foldings, which, as the embryos grow, unfold gradually making room for the developing embroyos. The surface shows closely arranged parallel lines. Setna and Sarangadhar (1948 *a*) have described the egg-cases of *P. cuspidatus* in detail and mention that the egg-case *R. djiddensis* is exactly similar to that of *P. cuspidatus*. Microtome sections of the wall of the egg-case of *R. granulatus* show three distinct layers (Fig. 1). Mallory's triple stain colours the inner and the outer zones orange and the middle layer light blue. The outermost is the thinnest layer and is composed of horizontal striations with lacunar spaces. The narrow light blue middle layer has a beaded appearance and the innermost thick layer is composed of horizontal striations with lacunar spaces. Similar sections of the wall of the egg-cases of *P. cuspidatus* and *R. djiddensis* show the three layers described above.

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[1] The term ovo-viviparity is here used to include those cases in which the eggs, enclosed in an egg-case, are retained in the uterus until the young ones hatch by rupturing the egg-case. There is neither a placenta formed nor is there a direct feeding mechanism by the trophonemata of the maternal uterine wall. The term viviparity, on the other hand, is used to include those cases in which the eggs undergo development in the uterus and the young ones hatch and usually there is the formation of the yolk-sac placenta or the maternal uterine villi or the trophonemata pour their secretion directly into the system of the embryo. The eggs may or may not be enclosed in an egg-case, which when present, is made up of only a thin diaphanous membrane.

Tiny protuberances are described by Nalini (1940) as occurring on the outer surface of the egg-case of *Chiloscyllium griseum*. These are not present on the egg-cases of the ovo-viviparous forms described here, the surface being smooth and even. Couch (1847) observed that the egg-case of a species of *Myliobatus* has the surface reticulated.

Nalini (1940) observed in the egg-case of *C. griseum* that the outermost layer is followed by a clear space and this has been interpreted to represent a slight pause in the secretory activity of the nidamental gland. In all the three species so far described by the author no such clear space has been noticed. If the clear space is to represent a quiescence in the secretory activity of the gland, as suggested by Nalini, then it seems that, in the species under consideration, when once the secretory activity of the gland has started there seems to be no pause until one egg-case is completed.

The maximum thinning of the egg-case has taken place in the typical viviparous forms, where the egg-case is made up of a thin diaphanous, elastic and transparent membrane which has a slight yellow or brown colour in most species.

In a specimen of *Galeocerdo tigrinus*, caught off the Madras Coast, each uterus contained twenty eggs, each enclosed in an egg-case. The egg-case of this species has already been described by Sarangadhar (1943). It is soft, thin and transparent with both ends highly folded. Between the egg and the egg-case there is a layer of albuminous fluid. The folds, as already mentioned in the case of *R. granulatus* and other ovo-viviparous species, unfold as the embroyo develops giving enough space for it. An examination of sections of the wall of the egg-case stained with Mallory's triple stain shows that it is composed of a single homogeneous compact layer as the sections are stained uniformly red. Striations and lacunar spaces which are seen in the sections of the egg-case of *R. granulatus* are not present here. In *Carcharinus dussumieri* one pole of the egg-case is continued as a long twisted cord, which is highly folded and has a golden colour. The cord measures from 220 to 250 mm. in length. The egg-cases of *Hemigaleus balfouri* resemble more or less those of *C. dussumieri* in appearance. Here too, one pole is continued into a twisted and highly folded cord measuring about 60 mm. In *Scoliodon palasorrah* there is a similar covering for the egg (Plate; photo. 2) but the long cord has been reduced to a small conical, highly folded and compressed tuft-like structure measuring about 15 to 20 mm. in length. The egg-cases of both *H. balfouri* and *S. palasorrah* have a light brown colour. The tiny egg of *S. sorrakowah* is covered over by a very delicate, transparent and colourless membrane. The egg-case (Plate; photo. 3) is pear-shaped and measures about 5 mm. by 3 mm. and it is likely that this happens to be the smallest egg-case known. The narrow part of the egg-case is drawn out into a small tuft, about 2 mm. in length when stretched out, whereas the tuft at the broad end of the egg-case is comparatively short. The egg-case is filled with a clear transparent liquid.

Microtome sections of the egg-cases of the last four viviparous species described were examined. Unlike the structure of the egg-cases of the ovo-viviparous forms, there is no differentiation into layers as revealed by the fact that the sections, when stained with Mallory's triple stain, take a uniform light red colour as in *G. tigrinus*. Lacunar spaces as well as striations are not present. All the egg-cases are composed of a single homogeneous compact layer.

The egg-cases are retained in the uteri, even in the viviparous forms, for a fairly long time and even after the young are liberated portions of the egg-case can be seen in the uteri. In certain forms like *Mustelus laevis* it has been noticed by Hoedemaker (as quoted by Mahadevan, 1940) that the membranous egg-case persists between the maternal and foetal tissues of the placenta. It permits ready diffusion of the milky nutritive fluid secreted by the uterine mucosa. According to Norman (1947) the egg-capsule formed in viviparous forms is absorbed later on.

FORMATION OF THE ELASMOBRANCH EGG-CASE

There is a good deal of uncertainty still on this subject. Earlier workers like Gerbe (1872), and Perravex (1884) held that the albumen and the shell are secreted simultaneously around the egg. The latter held that although secretion of the matter, of which the shell is composed, begins before the egg reaches the gland, yet the shell is actually formed when the egg reaches the gland. But Beard (1890) stated that in skates the lower half of the purse is formed before the egg enters the oviducal gland and the closure of the purse is effected soon after the arrival of the egg. Among the more recent workers Borcéa (1904) opines that the formation of the shell commences before the egg reaches the gland on the ground that the pressure of the egg within the gland would prevent the secretion from passing between the lamellae, at the base of which individual tubular glands open. Widakowich (1905), while describing the nidamental glands of *Scyllium canicula,* held that the caudal processes of the egg-case are laid down during the passage of the egg down that part of the oviduct which is cranial to the nidamental gland, but that the body of the

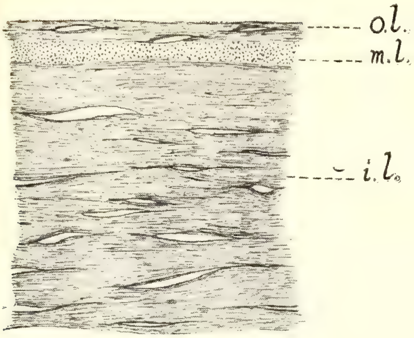

Figure 1. A section of the wall of the egg-case of *Rhinobatus granulatus.* Note the three distinct regions. × 600 (oil)

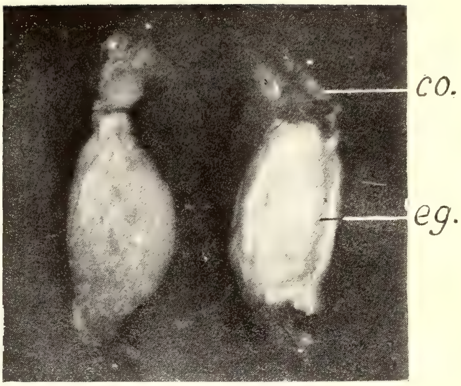

Photo 2. Egg-case of *Scoliodon palasorrah* *ca.* $\frac{2}{3}$ natural size.

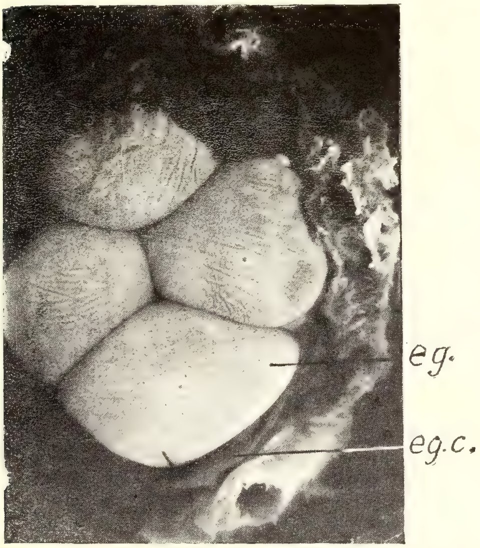

Photo 1. Egg-case of *R. granulatus* (in uterus) opened to show the eggs. *ca.* $\frac{1}{4}$ natural size.

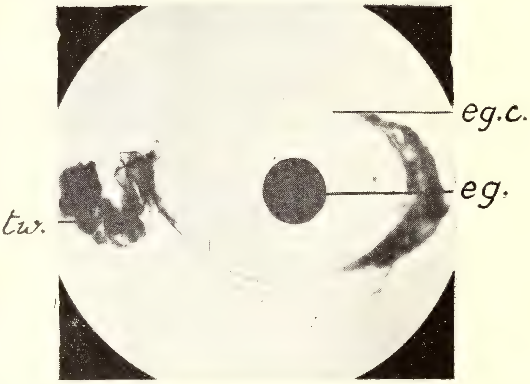

Photo 3. Egg-case of *S. sorrakowah.* Note the narrow end drawn out into a short cord. × 8

KEY TO LETTERING

co.	....	conical tuft.
eg.	....	egg.
eg.c.	....	egg-case.
i.l.	....	inner layer.
m.l.	....	middle layer.
o.l.	....	outer layer.
tw.	....	twisted cord.

egg-case is formed during the subsequent movement of the egg through the gland. Hobson (1930), after examining about 150 pregnant skates of several species, came across a single specimen in which the egg-cases were in the process of formation. He found ova in the upper oviducts, between the ostium and the nidamental gland, whilst the egg-cases were three-quarters completed; their only difference from the final product was their light colour and soft texture. The egg-cases were quite empty and the dorsal and ventral walls were well separated from one another. On the evidence of this he concluded that the posterior three-quarters of the egg-case is secreted before the ovum enters the nidamental gland and probably half of it before the ovum has left the ovary. Garrault and Filhol (1937) have described the mechanism of secretion of the different layers of the egg-case of *Raja batis* and *Scyliorhinus canicula* but they do not mention whether the secretion of the egg-case starts before the egg reaches the nidamental gland or after that. Metten (1939) examined several specimens in order to establish the truth or otherwise of Hobson's contention. He has given a record of a number of partially secreted egg-cases. According to him there was never an ovum present in less than three-quarters completed egg-case; nor was an ovum to be found undergoing migration in the coelom or upper oviduct in any fish where the egg-cases were half secreted or less. He was not able to find any fish in the exact condition of Hobson's skate, although he found fully formed egg-cases containing only albumen. But these were rather small, otherwise normal. Nalini (1940) rejects the view of the part formation of the egg-case and concludes that the secretions are poured over the egg after it reaches the nidamental gland. She also suggests that the mode of formation of egg-case may vary in different species of oviparous Elasmobranchs. Setna and Sarangadhar (1948 *a*) observed incompletely formed egg-cases in the nidamental gland of *Chiloscyllium griseum* and remark: 'The most interesting features were, however, presented by the incompletely formed egg-cases in both the nidamental glands of the female (Text-fig. 2c; Pl. I, fig. 2 left). Both of them were equal in development, similar in orientation, which itself was similar to that of the fully formed egg-cases and they were situated exactly opposite to each other. It was obvious that nearly two-thirds of their development had been completed, characteristically, from the posterior end forwards and that anteriorly they were open, the openings being fairly wide and irregular in outline. The fertilised eggs, surrounded by dense masses of transparent, gelatinous albumen, had already entered the egg-cases, and more albumen was seen to be still entering through the open ends'. While discussing the mode of formation of the egg-case in *C. griseum* the authors remark: 'Observations on the egg-cases obtained by us point to a lack of uniformity in the composition of the structure of the capsular wall in different regions and clearly suggest a non-synchronous activity of the shell-glands in different zones of the nidamental glands. These features, together with the very incomplete nature of the egg-cases encountered by us, thus support the former view, *that the lower half or more of the egg-case is formed before the egg arrives in the nidamental gland and that the closure of the purse is effected only* *after the entry of the egg in the partially formed egg-case,*[1] regarding the formation of the egg-case in oviparous forms.'

The above-mentioned observations have all been restricted to oviparous forms. The condition of the egg-case in the ovo-viviparous forms such as *Rhinobatus granulatus, Rhynchobatus djiddensis* and *Pristis cuspidatus* suggest the improbability of the egg-case being formed after the egg reaches the nidamental gland. The mode of formation of the egg-case, which the author believes to be of general occurrence in Elasmobranchs, would seem applicable to all forms. In all the ovo-viviparous species described, a single egg-case covers more than one egg. Usually the number varies from three to five. This arrangement stood against the acceptance of the view that the egg-case is being secreted around the egg or eggs after they reach the nidamental gland. If, according to Borcéa (1904), one egg in the nidamental gland can give so much pressure as to prevent the secretions from flowing out, what will be the pressure exerted on the gland by three to five large ova each measuring about 50 mm. in diameter?

Most of the previous workers agree that the formation of the shell commences before the egg reaches the gland. It has been doubted whether normal egg-cases can be formed, considering the highly sticky nature of the secretions, when there is no egg in the nidamental gland to keep its walls separate and to prevent the walls of the egg-case from collapsing (Nalini, 1940). The observations of Beard (1890) show that about ten per cent of some shark egg-cases laid in captivity were found to contain no egg. More instances of such egg-cases, containing no egg, have been recorded by Borcéa (1904), Metten (1939), Gudger (1940) and Smith (1942). These records substantiate the fact that the walls of the egg-case can remain separate even though there is no egg in between. Further, it is not unlikely that a certain quantity of albumen will be secreted into the egg-case that is in the process of formation and this will keep the walls from collapsing. As Metten (1940) has remarked some egg-cases, even though they do not contain the eggs, have albumen inside. Externally, these 'empty egg-cases, it is reported, are quite indistinguishable from others, except for their lighter weight. Such empty egg-cases are sometimes known as 'wind eggs'.

In a mature female specimen of *Galeocerdo tigrinus,* caught off the Madras Coast on August 10, 1944 measuring 3775 mm. in length, two eggs, one in each cranial oviduct, were seen migrating down into the nidamental glands. They had already travelled about one-third of the distance from the oviducal funnel to the nidamental gland. An examination of these glands revealed that they had already begun to secrete the egg-case and part of the egg-case formed could be traced from the lateral horns of the gland to the caudal oviduct. The portion that had already been formed would evidently constitute the highly compressed and twisted cord at one pole of the egg-case. The very fact that one seldom encounters a partly formed egg-case as the one mentioned here, suggests that the formation of the egg-case is rather quick and hence it is only by pure chance that one may come across a specimen with an incomplete egg-case in the nidamental gland and as Setna and Sarangadhar (1948 *a*) have pointed out a more intensive fishing during the breeding season may reveal the normality of the phenomenon of part formation of egg-cases.

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[1] Note: Italics by author.

In those forms where more than one egg is enclosed by an egg-case the theory of egg-case formation *en masse* does not seem to be applicable because all eggs which are to be enclosed by an egg-case cannot reach the nidamental gland simultaneously; even if they reach the gland in quick succession the glands will have to remain inactive until all the eggs reach the gland. So taking these facts into consideration the following conclusions may be drawn. The nidamental gland begins to secrete the egg-case as soon as ovulation takes place, whether ovulation be the only stimulus or not, and consequently when the egg reaches the nidamental gland there will be a partly formed egg-case to receive the egg. Fresh secretions, being in the form of granules and fibres, are dovetailed so closely as not to leave any definite suture. Further, it is important to emphasise that when once the secretory phase of the gland has started it stops only after the completion of an egg-case and thus the formation of the egg-case is a continuous process which eliminates the possibility of the presence of a suture denoting the line of fusion.

SUMMARY

1. Egg-cases of three ovo-viviparous forms viz., *Rhinobatus granulatus, Rhynchobatus djiddensis* and *Pristis cuspidatus* and five viviparous species viz., *Galeocerdo tigrinus, Carcharinus dussumieri, Hemigaleus balfouri, Scoliodon palasorrah* and *S. sorrakowah* have been described.

2. The egg-cases of oviparous species are thick and horny exhibiting distinct layers, while viviparous forms have thin and transparent egg-cases of a homogeneous substance not marked into distinct layers. In ovo-viviparous species the egg-cases formed are intermediate in their structure and thickness.

3. The probable mode of formation of the egg-case together with the stage at which secretion begins is suggested.

ACKNOWLEDGMENT

It is with extreme pleasure that the author records here his sincere thanks to Prof. R. Gopala Aiyar and Dr. N. Kesava Panikkar for their suggestions and criticisms.

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OBITUARY

BRIGADIER GENERAL REGINALD GEORGE BURTON

With deep regret we record the death of this old and valued member of our Society which took place at his residence, Bafford Grange, Charlton Kings, Gloucestershire, on the 2nd February 1951 in his 87th year.

Brigadier General Burton was the fourth son of the late General E. F. Burton of the Madras Staff Corps, all of whose nine sons—only one now living—followed their father's profession. He was commissioned in the First West India Regiment on the 23rd August 1884, and after a period of service in Jamaica came to India on appointment to the Bengal Staff Corps and the Hyderabad Contingent. Following a period of service on the H.Q. Staff at Simla he commanded the 94th Russell's Infantry (Hyderabad Contingent) from 1909 to 1913. In 1915 he was Staff Officer with the Force landing in Gallipoli where he was wounded and invalided home. In 1917 he was Commandant of the Cadet College, Wellington, Nilgiris, and in 1918 Commander of the Madras Brigade Area.

After retirement at Cheltenham he was 23 years Manager of the Boys' Sunday Schools, and 9 years Vice-Chairman of the Hospital.

In 1901 he married Elsie Mary, daughter of Mr. William Lumb of Whitehaven, and leaves one son, Reginald William Boteler Burton, Fellow and Vice-Provost of Oriel College, Oxford University who served in the Air Force all through the War and was mentioned in despatches.

R. G. Burton inherited both sporting and literary tastes. His 'History of the Hyderabad Contingent' was a masterpiece of its kind. His other publications included, 'Tropics and Snows' 1898; 'Sport and Wild Life in the Deccan' 1928; 'A Book of man-eaters' 1931; 'The Book of the Tiger' 1933; 'The Tiger Hunters' 1936. He contributed a number of articles to the '*Field*' and other papers in England connected with Natural History. He also wrote a number of books on military history and historical works on Indian campaigns for the General Staff, and published three volumes on Napoleon's campaigns, one of which is still the standard book on the campaigns in Italy.

When in Russia in 1893, he followed the track of Napoleon's invasion and afterwards passed as interpreter in the Russian Language. He was examiner in military history and strategy for the Indian Staff College in 1910.

Brig. Burton joined the Society in 1898 and contributed many notes and articles to the pages of its journal. A few may be mentioned: 'Bull Terrier and Tiger' and 'Jungle Notes' in Vol. 12; 'Wild Animals at Water' vol. 14; 'Big Game' vol. 16; 'Some Notes on Tigers and Panthers' vol. 17; 'The Drinking Habits of Wild Animals'; 'Fear of Man in Wild Animals'; 'Some Natural History Notes on Tiger';

'Notes on Panthers'; 'Old Deccan Days'; 'Wild Beasts—Real and Apocryphal' in vols. 18 to 21, and 'Panthers' vol. 26 (pp. 266-278).

Burton greatly enjoyed the extensive experiences of tiger shooting which he had with his brother Robert during the earlier years of his service with the Hyderabad Contingent during which they killed many tigers.

The class of sportsman-naturalist of whom R. G. Burton was a notable representative is fast vanishing from India to the lasting loss of the country to which they gave the best years of their lives.

R. W. B.

REVIEWS

1. BIRDS WILD AND FREE. By A. W. P. Robertson. 208 pp. $7\frac{3}{4}'' \times 5\frac{1}{2}''$. 45 photos. London, The Bodley Head, 1950. Price 16*s*. net.

It is eloquent of the popularity which bird study enjoys in England to-day that each Spring and Autumn unfailingly adds its quota to the already imposing array of books on birds—especially British birds.

Bird-watching, once somewhat disdainfully regarded as a pastime of the 'Idle Rich', has grown in popularity notably between the two world wars and more vigorously during and since the last. It is little exaggeration to say that as a hobby it now enjoys almost universal approval in Britain. It has demolished all class barriers and can claim its devotees from amongst every stratum of society and every walk of life. In the past its appeal was chiefly aesthetic, and the approach to it largely emotional. Academic highbrows treated it with tolerant condescension as a harmless enough though somewhat childish way of killing time, and of little scientific worth. The steady shift of emphasis in zoological research in recent years from the laboratory to the field has brought about a refreshing change in the scientist's outlook. Increasing attention is now being paid to the *living* organism—to problems connected with ecology behaviour, population dynamics, migration, and so on, and it is abundantly realized that morphological studies divorced from the living organism provide an incomplete and distorted picture of its evolutionary history and status.

Perhaps no other branch of field zoology offers the potentialities, and certainly none can boast of greater strides forward than have been achieved in the domain of ornithology. In England the establishment of the British Trust for Ornithology at Oxford is undoubtedly the most important single factor that has contributed to the change in the scientific outlook. It has given a new impetus to bird-watching all over that country. The number and variety of scientific problems that are being tackled by amateur ornithologists with the co-operation of the Trust's experts is considerable. This altered outlook on bird-watching is reflected in the number and general trend of the bird books that are now produced. The best of them are characterized by the possession of a sound scientific bias; they are simply and pleasingly written and are usually well illustrated. And this is the category into which I would unhesitatingly place the one under review.

'Birds Wild and Free' is a record of the author's observations and impressions on the behaviour and habits of his local birds, gathered mostly during the last ten years of war and peace. The record is illustrated by some excellent photographs by himself and his fellow-enthusiast Robin Powell. A great many of the observations were made while in pursuit of bird photography.

A garden of about one acre in Cheshire, carefully controlled by a party of nine enthusiasts working under the author's direction, produced no less than 60 nests of 21 different species, which is truly remarkable.

Long-tailed Tits nesting in the proximity of a hedge-sparrow's nest were observed to occasionally feed the chicks of the latter in addition to their own. A spell of wintry weather froze a lake on which paired-off coots were preparing to breed causing the birds to temporarily revert to their accustomed community life of the non-breeding season. One pair so affected had already built a nest !

The book is replete with interesting and often original observations on the behaviour and habits of various bird species made from the photographing hide, or in connection with the preparations for photography. They emphasize the unparalleled opportunities vouchsafed to the intelligent bird photographer for making detailed studies on almost every activity of the living bird.

The return of the Avocet as a breeding species to Britain after an absence of over a hundred years, and the measures employed to ensure its nesting success and re-establishment on the marshes make a fascinating chronicle. Readers of J. K. Stanford's 'The Awl Birds' will recognise in retrospect many of the incidents here recorded and around which that enchanting story was built up.

The march of the seasons in an English farming village, with its record of the arrivals and departures and the changing activities of birds is beautifully described, and the book ends appropriately with a chapter on Bird Identification which beginners will find of the greatest usefulness. As the author rightly observes 'It is a fundamental fact that you cannot accumulate information about a person, a bird, or anything else until you know its name; but once the name is known a great gap is bridged and information can accumulate like a snow ball.' Correct identification is indeed the *sine qua non* for intelligent bird-watching. No matter how careful or interesting an observation may be, it will be ruined and will lack real scientific worth unless the species to which it relates has been correctly identified.

It is some considerable time since I can remember to have enjoyed a bird book as much as this one, and I would recommend it strongly to all who love birds, aspire to bird photography or appreciate good descriptive writing.

S.A.

2. ISLAND OF SKOMER. Edited by John Buxton and R. M. Lockley. Pp. 164. Size ca. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. 17 plates and 3 maps London, Staples Press Ltd., Price 18*s*

Skomer is a wind-swept, almost treeless island, some 700 acres in extent, lying off the extreme west coast of Wales. It is almost surrounded by cliffs, but the main part of the island is only about 200 feet above sea level. The rainfall is fairly heavy and is distributed throughout the year. Consequently, there is a marsh, a stream and a pond on the island, and fresh water is always available. Formerly the island was inhabited by man, so there are a number of grassy-fields from which the stones have been cleared to form walls. To-day, the commonest inhabitants of the island are rabbits, shearwaters, puffins and other cliff-breeding birds—these birds, of course are only on the island during the breeding-season.

From March to October, 1946, the authors of this interesting book, together with a number of short-time assistants lived on the island, and carried out a careful and thorough survey, geological, botanical, zoological—the island is one of the breeding-places of the rare Atlantic grey seal—ornithological, entomological, marine-biological. There is a modest disclaimer that the survey of the island's natural life has been in any sense completed by six months' work. On the contrary, the authors hope that the publication of their book may stimulate other observers to continue the work, both on this and other Welsh islands—and why only Welsh? Perhaps Indian too.

R. M. Lockley lived for some years on the adjacent island of Skokholm; and one of the most interesting features of this book is the comparison that can be made between the biology of these two islands. Skokholm is three miles from the coast; Skomer a short half mile. Thus, although the sea-birds breeding on the two islands are the same and the visiting migrants are much the same, 'land' birds breeding on Skomer bring its breeding-total to 34 species, whereas Skokholm's total is only 21. Similarly, it appears that the Lepidoptera breeding on Skomer are in excess of those found on Skokholm. And the flora is astonishingly rich and varied. Fuller comparisons of the two islands would be valuable.

One of the most remarkable features of this little island is the presence of a small Vole, *Clethrionomys skomerensis*, which is not known from any other locality. It is a very tame animal. On the photograph facing page 88 it is described as 'a large insular variety of the Bank-vole'. But it is clear from the text that scientific opinion now accepts the view that it is a distinct species, probably at one time more widely distributed, which has somehow failed in the competition for existence in other parts of its range. It has been kept in captivity with the common Bank-vole, but the two animals would not interbreed.

The larger part of the book deals with the bird-life of Skomer. Many illuminating observations were made. Only one or two can be referred to here. In some of the gull colonies the Herring Gull (*Larus argentatus*) and the British Lesser Black-backed Gull (*L. fuscus graellsii*) breed side by side. These two species are only separable by the colour of the mantle in the adult and (in some subspecies) by the colour of the tarsus. Moreover, there seems to be complete intergradation from the palest grey subspecies of *L. argentatus* to the blackest subspecies of *L. fuscus*. Consequently, some authors insist that they should all be lumped as one species. Yet on Skomer they breed side by side and do not interbreed. Careful observations were made on their feeding-habits. Both species are more or less omnivorous, and no specific differences in feeding-habits could be detected. The young birds are usually indistinguishable from one another. Yet, when the breeding season is over, the brown young Herring Gulls spend the autumn and winter roaming over the North Atlantic and the North Sea, while the brown, young Lesser Black-backs nearly all migrate to south-west Europe and north-west Africa. A multitude of ringing results demonstrate this.

The autumn of 1946 was so stormy off the Welsh coast that very little bird migration could be observed; and in one severe storm the yacht was battered to pieces. So the party were driven away to the shelter of a world where there is better protection from the elements. In spite of disappointments however, in the final chapter the authors write: 'The last word of knowledge can never be written about any living thing—the joy of discovery, which is the inspiration and reward of all honest search for true knowledge, ever remains.'

Perhaps the fascinating story told in this book will stimulate a group of young Indian naturalists to start a survey of Elephanta Island or of some other compact little universe within Indian waters.

H. G. A.

3. SUPPLEMENT TO THE BOTANY OF BIHAR AND ORISSA. By Herbert Mooney. 1950. Catholic Press, Ranchi. 18.5 × 12.5 cms., Pp. iii, 294.

This is an excellent supplement, the result of many years of active work in the field, for which the author deserves the congratulations of Indian botanists. The printers on their part have spared no effort to make this book a model of its kind in India.

In the introduction, the author mentions a large number of plants which have not been recorded for his district by any of his predecessors; the list is an impressive one particularly for a region that had been so thoroughly explored by Haines. The discussion on the vegetation of several special tracts is of great interest.

There is but one fault that this reviewer can find with the book, and this is in connection with the nomenclature of the plants listed therein. It is the avowed aim of the author (see p. iii) to bring the nomenclature up to date; this is a difficult enterprise especially for a field worker who spends most of his time away from the better libraries.

On p. 24, to cite but one example, the author lists *Polycarpaea corymbosa* (Linn.) Lamk., and the reference to Linne as the author of the specific epithet is in accordance with the Intern. Rules of Bot. Nomencl., Art. 49; generally, however, the author omits such references. In my opinion a uniform policy of either giving such references or omitting them everywhere, would be more consistent.

On p. 25 *Mollugo lotoides* is attributed to Clarke in Hook. f., Fl. Br. Ind. 2: 662, 1879. As far as I have been able to discover, the combination should be attributed to O. Kuntze in Rev. Gen. Pl. 264, 1891. Clarke, loc. cit., gives *Mollugo hirta* Thunb.; and lower down on the same page, *M. hirta* var. *lotoides*. On p. 776 of the Index Clarke lists *Mollugo lotoides* Wt. & Arn. as a valid species; Wight and Arnott, however, in their Prodromus p. 362 mention *Glinus lotoides* Linn. and not *Mollugo lotoides*. The combination must, then, be attributed to O. Kuntze, who was the first clearly to publish it.

On p. 34 Mooney mentions *Breynia patens* Benth. The generic name *Breynia* Forst. is an invalid one, in the words of Croizat (in Sargentia 1: 48, 1942) 'on two counts. It is a later homonym of *Breynia* L. (Sp. Pl. 503, 1753) and a *nomen confusum,* a mixture of *Breynia* sp. and *Phyllanthus distichus* L.' The oldest valid name for *Breynia* Forst. is *Melanthesa* Blume, in Bl. & Fisch., Fl. Jav. 1: vii in note, 1828.

P. 67. *Ammannia tenuis* Clarke. The genus *Ammannia* has recently been revised by Koehne in Engler, Bot. Jahrb. vol. 1, 1880 and in Engler, Pflanzenreich iv. 216; more recently still Blatter and Hallberg revised the Indian species of the genus in this journal, vol. 26. The plant in question is now called *Rotala tenuis* (Willd.) Koehne in Engl., Bot. Jahrb. 1: 172, 1880.

P. 78. *Bidens pilosa* Linn. Sherff in 1937 published two monumental volumes on the genus *Bidens;* the common Bombay plant is according to Sherff *Bidens biternata* (Lour.) Merr. & Sherff; it would be interesting to know exactly what Mooney's plant is in the new revision of the genus, since *B. pilosa* seems to be actually rare in this country.

P. 83. *Centunculus pentandrus* R. Br. This plant belongs to the *Primulaceae,* not the *Plumbaginaceae* as stated by Mooney, obviously by mistake. The correct name according to the revision of the family by Pax and Kunth (in Engler, Pfreich. 22: 331, t. 71, 1905) is *Anagallis pumila* Swartz.

P. 86. *Anodendron manubriatum* (Wall.) Merr. for *A. paniculatum.* The reason for the change as effected by Merrill is not obvious; Wallich's *Echites manubriata* is in fact the oldest name for the plant, but at the same time it is a *nomen nudum* and therefore of no value from the point of view of taxonomy and nomenclature. Roxburgh's *Echites paniculata* (1832) is invalid as being a later homonym for *E. paniculata* Poir. But in the genus *Anodendron* the combination *A. paniculatum* A. DC. is the oldest one for the plant in question, and I fail to see why such a name is considered invalid by Merrill.

P. 87. *Hoya pendula* Wight, Icon. t. 474, 1850 (not of Contrib.) If Mooney is correct in distinguishing the plant of Icon. (1850) from that of Contrib. (1834), then surely the former name is invalid, since it is a later homonym; see Art 61.

P. 89. *Cordia dichotoma* Forst. f.; this name is correct, but the explanation given by the author is not. Linne's *Cordia myxa* is the oldest of the three names mentioned by Mooney, and has priority over the other two names, but *Cordia myxa* Linn. is now considered a different plant from the one commonly known under that name in Indian floras.

P. 93. *Ipomoea hederacea* Jacq. This plant is a native of America and in Indian floras and herbaria is often mixed with a native Indian plant, *I. nil* Roth; it would be interesting to know precisely which of the two plants is meant as occurring in Orissa.

P 109. *Ruellia* sp. The genus *Ruellia,* as far as Bombay is concerned, is represented only by the American introduced plant *R. tuberosa* Linn. The other Indian species of the so-called *Ruellia* have been shifted to other genera by Bremekamp.

P. 116. *Barleria montana* Nees. This plant does occur in India, but very often it is mixed with two other species, *B. gibsoni* Dalz. and *B. prattensis* Sant. It would be interesting to find out which of the three species precisely is the plant in the Supplement.

P. 120. *Lippia nodiflora* Rich. The correct name for this plant is *Phyla nodiflora* (Linn.) Green in Pittonia 4: 46, 1899.

P. 120. *Lantana camara* Linn. is a very rare plant in India, if it does occur here at all; the common spiny plant is *L. camara* L., var. *aculeata* Moldenke, or *Lantana aculeata* Linn.

P. 139. *Salix tetrasperma* Roxb. belongs to the family Salicaceae, not to the Moraceae.

P. 204. *Burmannia coelestis* Don. Is this the typical variety or *B. pusilla* Thw.?

The price of the book (about Rs.19) is rather stiff for a book of only 300 pages.

H. SANTAPAU, S.J.

4. THE FLAMINGOS OF THE CAMARGUE. By Etienne Gallet. Translated from the French by Sumner Austin. With 53 photographic illustrations by the author. Pp. 127 Size 9″ × 3¾″. Oxford, Basil Black, 1950. Price 15*s*. net.

5. FLAMINGO CITY. By G. K. Yeates, F.R.P.S. with a map and 44 photographic illustrations (6 in colour). Pp. 209. Size 9¼″ × 6″. London, Country Life Ltd., 1950. Price 25*s*. net.

Despite the popularity which the flamingo has enjoyed through what one may call the bird-conscious centuries on account of its striking form and colouration and the vastness of its normal congregations, there has clung to it (and still clings) a certain haze of mystery. We are in comparative ignorance not only of the true nature and extent of its seasonal movements but also of practically every other detail concerning its life history, including its food.

The three best known and most populous breeding grounds known in the Old World are (1) the marshes (marismas) in the delta of the Guadalquivir river in Southern Spain, (2) the tract known as the Camargue in the delta of the Rhone in southern France, and (3) the Great Rann of Kutch in north-western India. We have little recent information regarding (1). All that is known about (3) is embodied in two papers in the *Journal of the Bombay Natural History Society,* the first by C. McCann (Vol. 41, pp. 12-38. 1939) and the second by Sálim Ali (Vol. 45, pp. 586-92. 1945). Although the Camargue has been known as a breeding ground for over 70 years and references and odd notes on the flamingos there have appeared from time to time from the pen of several visiting ornithologists, Mons. Gallet is perhaps the only resident ornithologist who has used his unrivalled opportunities to investigate the nesting colonies closely and over a fairly continuous period. His attempt to lift the veil from many aspects of the flamingo's life history is admirable indeed, and the remarkable photographs which form such a prominent part of his book can claim to be the finest series ever taken of this extraordinary bird in its native haunts and at its domestic avocations.

Some of the points on which doubt and uncertainty prevailed—not yet entirely dispelled in spite of M. Gallet's pointed suggestions—may be mentioned:

Seasonal Movements: According to the author flamingos arrive in the Camargue, leisurely following duck and coots, as the temperature rises in spring. Where they come from remains a subject of speculation. It will be remembered that McCann even suggested a swing between Kutch and Spain and Camargue owing to unfavourable phenological conditions at either end. There have been no recoveries of the young birds ringed in Kutch in 1945 to provide any clue, but of a number marked in Camargue in the summer of 1950, 1 was recovered from Toulon 200 km. east, 2 from the mouth of Ebro River in Spain, 1 from Oran in Algeria and 1 from Tunisia suggesting that their wanderings may in fact be quite widespread. The marking method is obviously the only way in which this puzzle will finally be solved, and it is to be hoped that serious attention will be centred on this matter wherever the flamingo nests.

Food: Investigators have been intrigued by the almost microscopic quantity of solid matter invariably found in flamingos' stomachs upon dissection. Animal as well as vegetable matter has been recorded, but the quantity of solid food, even in healthy birds killed in the act of feeding has been far from adequate to suggest that this comprises the staple diet of the species. The major proportion of the stomach contents is usually slimy mud intermixed with sand. M. Gallet suggests that the birds derive their sustenance chiefly from the organic matter contained in the mud scoped up from the bottom of the shallow brine or under the surface crust of crystallised salt. That flamingo chicks are able to subsist for weeks, and even grow fat in an area where nothing is apparent besides heavily concentrated brine in which no living organism can exist, is quoted in support of the suggestion that it is this slimy organic mud which supplies the necessary nutriment. A comparative analysis of the slimy bottom mud and the sand left behind on a patch where a flamingo had been feeding showed that as much as 6 to 8% of organic matter had been extracted. M. Gallet's suggestion is worth critical examination; it may well prove to supply the answer, as he believes.

M. Gallet believes that the sense of smell plays an important part in the recognition of nests by their owners inside a congested flamingo colony. A mass of birds disturbed off their nests after dark returned later, each bird finding its own nest by passing its bill over the surface of each nest, neck drooped and swaying like a trunk. The same manoeuvre is said to be employed during day time as well. The author's experiments showed that an adult bird does not recognise its egg or chick, but only its nest. If 2 or 3 chicks have scrambled on to a nest in confusion, the returning mother pushes off the extras indiscriminately till her quota of only a single chick is left. That this is done without bias for her own offspring was ascertained by marking rightful chicks with a woollen thread.

A great many points of absorbing interest in the life and progress of a breeding colony are touched upon. Many of the author's observations are highly suggestive, though it is sometimes difficult to decide from the text (no doubt partly due to losses in translation) which are based on fact and which are mere surmise. Unfortunately the style of his writing is not what one is normally accustomed to, or expects, in a modern scientific bird book, even of the more 'popular' type. This reviewer, being a brutally prosaic person himself, would have been glad to dispense with of the poetic emotionalism and romanticism which in his opinion mars what is otherwise perhaps the most outstanding first hand contribution to flamingo lore of recent times, and certainly unique for the magnificent photographs that go with it.

In spite of its name, our second book 'Flamingo City' contains much else that is strictly speaking beyond 'urban' limits. A large part of the book deals with what one may perhaps call Flamingo City's suburban population, species like the Purple Heron, Black-winged Stilt, Roller, Bee-eater, Hoopoe and others which though they may seem somewhat commonplace to us in this country are precisely what draw large numbers of enthusiastic bird lovers to the Camargue every year and infect them with a sort of chronic ecstasy for which the only antidote is a visit to more tropical climes ! Not that an antidote is necessary or even desirable, as any one reading Mr. Yeates's eloquent raptures will agree. There are certain human 'afflictions'—and bird-watching according to some is one of them—which some of us can suffer cheerfully, and continue to suffer, indeed even be thankful for.

Mr. Yeates's well-deserved fame as a bird-photographer stands fulfilled in 'Flamingo City'. Some of his photographs, particularly of the Purple Heron, Pratincole (coloured) and the group of flamingoes titled 'Morning Light' (p. 165) are truly superb. The text is interesting and often quite amusing, but is in the main a narrative of his visits to the Camargue in quest of bird photographs, above all of the flamingo. The accounts of birds are on a rather anectotal level with particular appeal to bird photographers, and add but little to scientific knowledge. Even the section dealing with the flamigo, of which he was fortunate enough to visit the 1948 colony in occupation, is largely a re-hash of previous literature on the subject, a complete and very useful bibliography of which is given at the end. In the list of abbreviations on p. 203, *J.B.N.H.S.* stands for *Journal of the Bombay National* (sic) *History Society* !

Appendix 1 'A Review of our Knowledge of the Flamingo' is a résumé of all that has been published about the bird arranged under the following sections: 1. The Mystery of the Nesting Grounds, 2. The Problem of Discovery, 3. Nesting Range and Distribution, 4. Nesting Habits, 5. Food, 6. The Future of the Flamingo.

The author's frequent emphasis on the intolerable heat experienced when working from a hide in the Provencal summer should make European readers reflect on how much more and continuously trying must be the climatic factor for the bird photographer in the tropics. It is only in this perspective that a proper appraisal of the work of such of our own pioneers as R. S. P. Bates and E. H. N. Lowther must be made for the excellence of their results to be truly appreciated.

Both these books will form a welcome addition to any bird-lover's library.

S. A.

6. TRAPPING METHODS FOR BIRD RINGERS. By P. A. D. Hollom. Field Guide No. 1 published by the British Trust for Ornithology, Oxford. 40 pages, $8\frac{1}{2}'' \times 5\frac{1}{2}''$. 24 text figures. 1950. Price 2*s*. 6*d*.

One of the chief difficulties facing those who wish to ring birds either for migration or life history studies is the catching of them. This has retarded marking very considerably and thereby the accumulation of data concerning individual birds which only this method can provide.

The British Trust for Ornithology and Mr. Hollom are to be congratulated on producing this extremely useful and much-needed pamphlet dealing with traps and nets for catching birds for marking purposes. In its 40 pages numerous types of automatic and non-automatic traps and nets are described, with diagrams and exact dimensions. Many of them are of a design simple enough to get constructed locally almost anywhere without the need of elaborate material or special skill.

Our knowledge of the life histories of even our commonest birds e.g. House Sparrow and House Crow are woefully limited and unprecise. There is no more satisfactory method of learning facts about individual birds than by marking them. Coloured rings, which can now be supplied by the Society for some of our smaller passerine birds, are easy to put on and afford a certain means of recognizing individuals at a distance and of following their daily movements, chores and occasions.

With the help of this pamphlet the catching difficulty can be easily overcome, and a pleasant and enjoyable way of adding to scientific knowledge lies open for everyone who takes an intelligent interest in birds.

Copies can be had from the Society, or direct from the Secretary, British Trust for Ornithology, 91, Banbury Road, Oxford. It is hoped that full advantage will be taken by the numerous correspondents who write to us for advice about trapping methods from time to time.

S. A.

The following books have been added to the Society's Library since January 1951:—

1. Mammals of North America. By Victor H. Cahalane (The Macmillan Company, 1947).

2. Birds of the West. By Ernest Sheldon Booth (Stanford University Press, 1949).

3. Simple Experiments in Biology. By Cyril Bibby (William Heinemann Ltd., 1944).

4. Supplement to the Botany of Bihar and Orissa. By Herbert Mooney (Published under the authority of the Government of Orissa, 1950).

MISCELLANEOUS NOTES

1. RABIES IN THE PANTHER; TWO PROVED INSTANCES

Owing to an unfortunate circumstance the *Indian Medical Gazette* for October, 1950, was not received by me until after the article on Rabies in the Tiger had gone to press.

In reply to my enquiry with reference to the opening paragraph of Dr. Pandit's article to the *Medical Gazette*, the Director of the Central Research Institute, Kasauli, Punjab (India) writes to me on the 25th January 1951:

'Between the years 1908 and 1949 there has been a total of 9 deaths due to hydrophobia in persons bitten by rabid panthers as recorded in the statistics of the Pasteur Institute of India, Kasauli, and of the Central Research Institute, Kasauli.

The most recent case of this description occurred in 1949.'

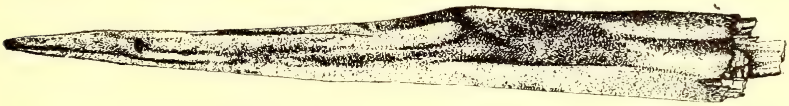
In view of the above it would seem most advisable for all persons mauled by panthers in this country to be given anti-rabic treatment without delay.

BANGALORE, R. W. BURTON,
27th January, 1951. *Lt.-Col.* I.A. (Retd.)

2. AN EXTRAORDINARY FIND IN A PANTHER'S STOMACH

(*With a text figure*)

I am sending you per separate registered postal parcel, a piece of dry wood, broken at one end, and pointed at the other, which was found in the stomach of a large panther I shot on 3-10-1950 in the vicinity of Koira, Bonai, Orissa.



Actual length tip to top 9·2″
Maximum thickness 1.2″
,, circumference 3.4″

There was no scar or any such mark on the outside of the belly portion of the beast to indicate that it had been speared from that side. The local villagers, however, told me that the barb seemed to be a broken piece from an implement used by them for digging out edible roots in the forest. Their theory was that the panther in attacking a person or his cattle in the forest had received a thrust with this implement in the mouth, causing it to break and swallow the sharpened end. There was no scar noticeable in the mouth, but one of the upper small teeth was dislodged.

I would very much like to have your views as to the possibility of any such occurrence as this after examining the wooden piece, and the period it could have remained in the stomach of the panther.

P.O. Bara-Jamda, A. TULLOCH
Orissa,
27th October 1950.

[It is indeed an enigma how such a large and jagged piece of hardwood—undoubtedly some roughly fashioned digging tool or spear-head—could have found its way to the panther's inside without causing any noticeable damage to its mouth or throat. That it had not lodged within for any considerable time is evident from the sharpnesses of the point and at the fracture where the piece had snapped off. They had as yet lost nothing of their roughness through the action of the gastric juices. It must have caused much discomfort to the luckless animal, and it seems a wonder that the points had not perforated the stomach during peristalsis.—Eds.]

3. ON THE 'THORN' OR 'CLAW' IN PANTHERS' TAILS

(*With 3 X-ray photos*)

With reference to the last line of your editorial comment on my note in Vol. 47 of the *Journal* (p. 718, August 1948) regarding the apparent absence of similar malformation in tails of tigers, I now have pleasure in being able to send you the end of a tiger's tail possessing the same feature. This tiger (male) was shot in June in the Wynaad, north of the Nilgiris, by an Indian gentleman. It was of exceptional size, both in length and girth.

A preliminary examination of the tail by trans-illumination, with an ordinary 2-cell electric torch in a darkened room shows that, while there is no dislocation existing, the curved 'claw'—nearly 1½ ins. in length—consists of four caudal vertebrae; and that, just beneath their junction with the next bone of the main part of the tail, is an opacity which might be mistaken for a totally displaced bone from the vertebrae. This I consider to be, however, a naturally developed lump of dense cartilage if not actually ossified cartilage or tendon (in medical parlance a 'sesamoid bone') developed either by the play of a tendon over a joint, or to serve the purpose of a fulcrum for using it the more easily (the human knee-cap being a constant structure as such). And, perhaps, it is because of this node in the tail of felines that they can twitch the tip independently of the remainder.

In the case of the X-ray photographs of the two panthers' tails, it seems likely that too much attention had been drawn to the dislocations revealed in these small specimens—at least for casual observer to note the slight resemblance to the curvature of a claw in the terminal portions. In the case of the larger tail such displacement was, in my opinion, obviously of recent occurrence—probably a sesamoid bone. (If it was a cartilaginous nodule, the X-ray would scarcely reveal it, if at all.) The smaller specimen—but also from a heavy, adult panther—does show what seems to be a completely displaced vertebra where a sesamoid bone might naturally develop; except that, in this one, it lies on top of two adjoining vertebrae—though, frankly, I do not yet know which ought to be the upper and which the lower surfaces of these tails!

However, I am sure that an X-ray illustration of the distinctively claw-like curvature in the tip of the tail of this very large and old tiger will afford an interesting study.

My grateful acknowledgements for so carefully procuring the specimen for me, are due to the willing co-operation of Messrs. Neale & Bosun of Mavinhalla (Wynaad).

WALMER,
LOVEDALE, NILGIRIS. K. BOSWELL
6th July, 1950.

[Dr. F. C. Fraser of the British Museum (Natural History), to whom Mr. Boswell's letter and specimen were submitted for opinion, writes:—

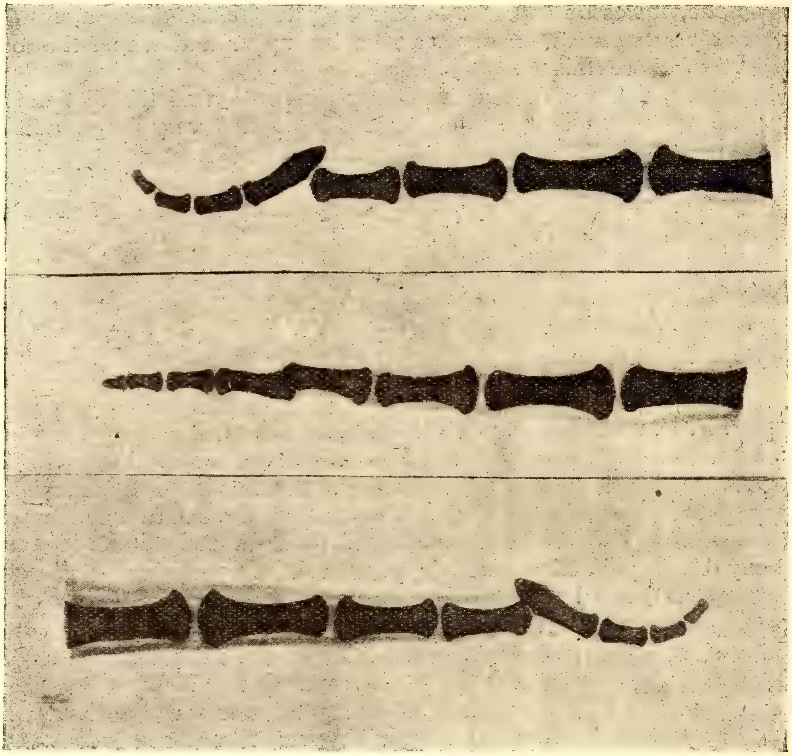
"The terminal portion of the tiger's tail has been examined and X-ray photographs taken of it. The 'claw' proves to be connected with a dislocation of the vertebra fourth from the end of the tail. A bony blunt pointed process is present at the proximal end of the displaced vertebral body, which appears to be an integral part of the vertebra concerned and not a 'sesamoid' as suggested by your correspondent. It is marked off from the body of the vertebra by a shallow well-defined depression which can be seen in the X-ray photograph. The explanation of the existence of the process is for a pathologist to give, but the presence of the limit between it and the body of the vertebra suggests that hypertrophy of the proximal epiphysis may have developed as a consequence of the dislocation, by the removal of the epiphysial face from juxtaposition with that of the vertebra immediately anterior to it.

The vertebrae distal to the dislocated element are not symmetrical. On the side of the tail to which the dislocated bone is displaced, each of the four terminal vertebrae is slightly concave and it is the sum of these concavities which forms the curvature of the 'claw'. On the other side the margins of the vertebrae are very nearly straight.

With reference to the larger panther's tail figured in your journal Vol. 47 (1948), p. 717, I disagree with your correspondent's opinion that the displacement was obviously of recent occurrence and probably by manipulation during skinning. Inspection of the vertebral body immediately distal to the first dislocation shows that it is curved and in general modified to a degree sufficient to point to alteration during the animal's life and it is fair to think that it is a result of the dislocation displayed. The vertebra distal to the second dislocation is also curved in a similar manner."

The X-ray photographs were sent to Dr. Osman Hill, the Prosectorium, The Zoological Society of London, Regent's Park, who has replied as follows:—

"With regard to the radiographs of the tiger's tail, I am fully in agreement with your general diagnosis. The conical process on the proximal end of the 4th vertebral body from the tip is a mass of osssified callus that has arisen as a result of a previous dislocation. It is a very fine radiograph as regards details of the trabecular system. The process is certainly not a sesamoid as suggested in Boswell's letter, as this term is restricted to ossifications in tendons or fibrous tissue away from the main skeleton, and remaining discontinuous therewith.



I do not think that the shallow depression delimiting the bony process is purely a surface phenomenon, as there is a distinct internal plate of bone representing possibly a juxta-epiphysial plate, the cervical process being perhaps caused by overgrowth of a displaced epiphysis during early life, finding itself subject to abnormal forces in its new environment. That the condition is of some chronicity is determined further by the remoulding that has been necessary to produce the marked curvature on the three vertebrae distal to the injured one. This strikes me as an attempt at compensatory straightening of the tail to make up for the bad alignment produced by the callous overgrowth, a feature commonly found in relation to malunited fractures.

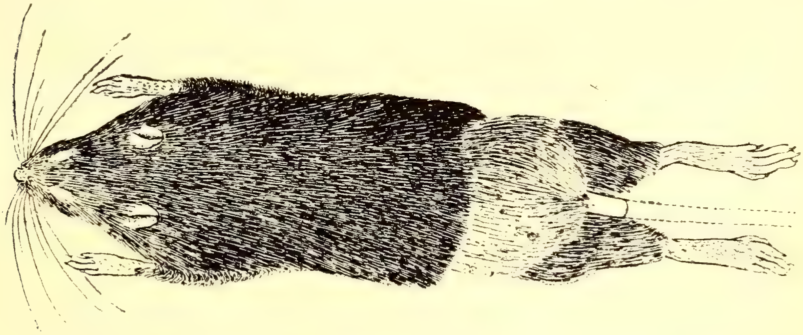
That the condition is of traumatic origin I am certain. It has no relation to the so-called 'claw' or 'prickle' at the end of the tail of the lion and other felines (known since the days of Homer) which is a purely cutaneous phenomenon without relation to the bony skeleton, except for the support given to the horny process by the tip of the last caudal vertebra (vide Turner, *J. Anat.* 7, 271-273 and earlier authorities there cited)".—EDS.]

4. AN ABNORMAL SPECIMEN OF *MUS PLATYTHRIX GRAHAMI* RYLEY (RODENTIA: MURIDAE) FROM KHANDALA, BOMBAY PROVINCE

(*With a text-figure*)

A specimen of the mouse collected at Khandala (W. Ghats) in October, 1949, was sent by the Bombay Natural History Society to the Zoological Survey of India for determination. As the specimen is of considerable interest, the writer has thought it fit to report on it.

It differs from the two other specimens of apparently the same form, collected later from the same locality, in the possession of a peculiar, more or less triangular area occupying nearly one third of the total head and body length, on the posterior part of the dorsal surface. The most remarkable feature of this area is that the spines, which are the chief covering material for the rest of the body, have been reduced to the point of almost total disappearance, and only a very few can be made out by careful examination. Their place has been taken by the hairs which are much more numerous than on the rest of the body, and are almost the sole elements of body coat of this area. The tips of the hairs lend a general apricot-buff colour to this zone which, thus, becomes very prominently contrasted against the anterior part



An abnormal specimen of *Mus platythriz grahami* Ryley from Khandala. × 1/1 (approx).

(Due to the backward bend of the spines and the hairs the actual limits of the spineless area are not well-defined in the drawing.)

of the dorsal surface which has a general black hue due to the black tips of the spines. The few spines which are found in the area under consideration are also tipped with apricot-buff like the hairs. The spineless area gradually passes into more posterior parts where the spines again preponderate over the hairs.

The body measurements in the fresh state are wanting. The tail is broken but healed up leaving a short stump behind. As compared with the skull of one of the specimens collected later (in the other it is damaged), the skull of the abnormal specimen is slightly smaller and has its molar crowns less worn out, thereby indicating its younger age. There appears to be every justification to consider the specimen as only an abnormal individual of the form; but, at present, no plausible explanation can be given as to the cause of disappearance of spines on a particular part of the body.

ZOOLOGICAL SURVEY OF INDIA,
INDIAN MUSEUM, CALCUTTA, H. KHAJURIA
5th November, 1950.

[The attention of the Zoological Survey of India was drawn to the fact that the original specimen was sent to the British Museum where it was identified as *Mus phillipsi fernandoni* (of which they had only 2 skins and 2 skulls for comparison) but with rather unusual pelage.

Dr. B. S. Chauhan replied that the Zoological Survey had followed Ellerman's Key to the Rodents inhabiting India, Burma and Ceylon (*J. Mammalogy*, Vol. 28, Nos. 3 and 4, 1947, p. 386) which reads:—

'*Fernandoni* resembles *platythrix* in a general way, except for its apparently shortened muzzle, the diastema being normally less than one-quarter of occipito-nasal length.'

He goes on to say that the diastema in the specimen under consideration definitely exceeds the proportion stated above, and that after a careful consideration of all the characters of the specimens he finds no reason to revise the Zoological Survey's identification.

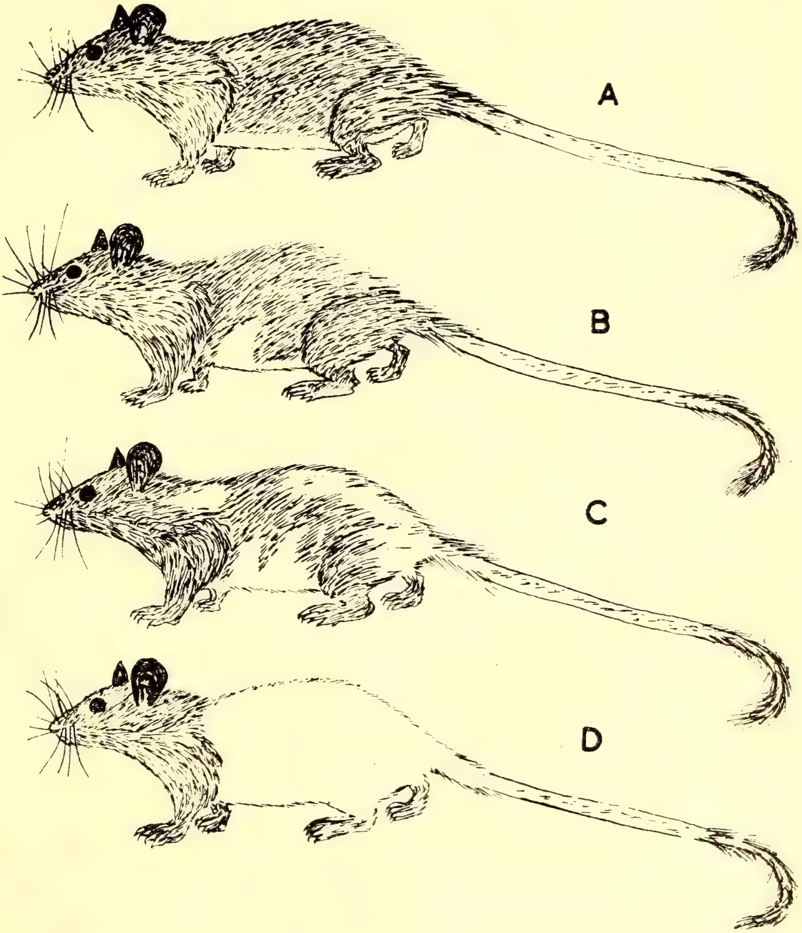
It may also be pointed out that *fernandoni* was originally described from Ceylon and is believed to be restricted to the island.—EDS.]

5. ALBINISM IN *RATTUS CREMORIVENTER* (MILLER)

(*With 4 text-figures and a map*)

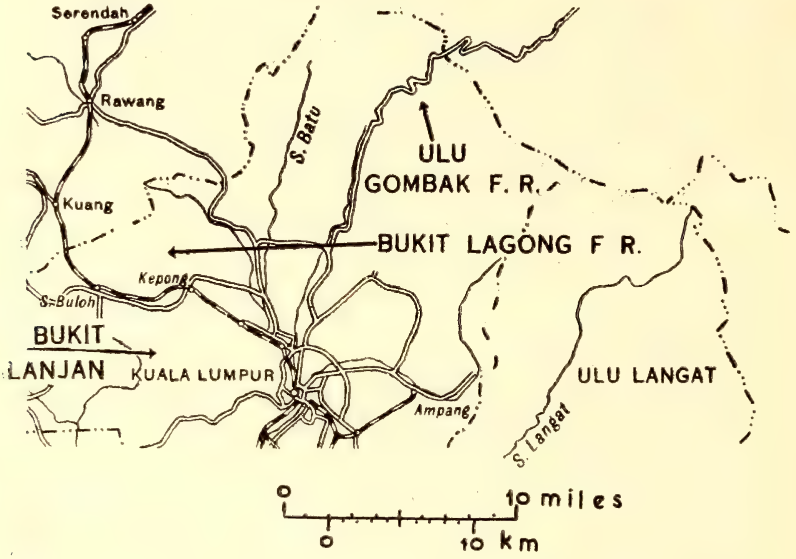
Recent correspondence in these pages (**48**: 579 and **49**: 298) has drawn attention to the lack of exact knowledge about the natural occurrence of albinism in rats, and to the doubt which must always exist as to whether its occurrence in house rats can be regarded as natural or due to the release or escape of domestic white rats. It is, therefore, of considerable interest to record the occurrence of partial albinism in a rat which is reasonably certain to be free from any admixture of domestic strains.

In connexion with work on scrub typhus, a large number of small animals are regularly collected from within a radius of about fifteen miles of the town of Kuala Lumpur, in the state of Selangor, Malaya. Among other habitats, a number of forest reserves are trapped, and in these is to be found an arboreal rat *Rattus* (*Maxomys*) *cremoriventer*. This rat is strictly arboreal and therefore quite different in habits to *Rattus* (*Rattus*) *norvegicus* to which the white domestic rats belong. The possibility of hybridisation with an arboreal forest rat of a different subgenus is therefore so remote as to be safely ignored.



The rat is normally brown with a white or yellowish belly, as shown in the drawing (text figure A). In the Selangor specimens the belly is typically white. Of the 87 rats of this species trapped during 1949 and 1950, however, 32 have shown an extension of the white up onto the flanks. In most specimens the extension consisted merely of a band of white on one or both sides as shown in fig. B, but in four specimens the white has been much more extensive, appearing as patches on the back such as is shown in fig. C.

In a fifth specimen the white was uniform over the whole of the hinder part of the body, leaving only the head and shoulders pigmented (fig. D). This specimen was juvenile.


Serendah
Rawang
Kuang
Kepong
S. Buloh
S. Batu
ULU GOMBAK F. R.
BUKIT LAGONG F R.
BUKIT LANJAN
KUALA LUMPUR
Ampang
ULU LANGAT
S. Langat
0
10 miles
0
10 km

These aberrant specimens were not confined to one locality, but occurred wherever the rat was trapped in any numbers, as is shown in the table and map. Although the numbers are small, the proportion of aberrant rats observed from each locality agree very closely.

TABLE

Collecting area (Forest Reserve)		Total number collected	Number of aberrant specimens			
			Total	Type		
				B	C	D
Bukit Lagong	...	72	28	25	2	1
Ulu Gombak	...	9	2	2	0	0
Ulu Langat	...	5	2	0	2	0
Bukit Lanjan	...	1	0	—	—	—
Total	...	87	32	27	4	1

J. L. HARRISON
LIM BOO-LIAT

SCRUB TYPHUS RESEARCH UNIT,
INSTITUTE FOR MEDICAL RESEARCH,
KUALA LUMPUR, MALAYA.
19th December, 1950.

6. PROTECTING FOOD CROPS FROM WILD ANIMALS

It might interest some of your readers to learn that a Wolseley Electric Fencer can be used with success in keeping elephants and other animals out of crops. This simple unit is produced by the Wolseley Sheep Shearing Company in the U.K., and is a very compact little affair. Either an inert 6-volt battery, available from the same company, or an ordinary car battery can be used with the apparatus. I found a single line of electrified barbed wire, set about 3 ft. from the ground round the cultivated area was sufficient to keep elephants and sambar out. To keep chital and pig out I added 2 lines of unelectrified barbed wire under the electrified line at 2 ft. and 1 ft. The current is naturally, only switched on at nights. The shock, though not dangerous, is quite appreciable; about equal to that felt on contact with an automobile plug wire. It is essential of course to make a periodical inspection of the wire to ensure that no jungle growth, twigs etc. are touching the line as such will tend to gradually short-circuit the battery. Elephants attempted to raid our ragi fields, protected by the 'electric fencer', on four occasions, and were repelled on contact with the wire each time; twice an elephant was 'stung' on its trunk first and then, swinging round, got it on its backside and pushed off!

On a moonlight night, before the unelectrified lower lines had been added, a tiger and a wild boar had, while having a skirmish, got into the field; and the encounter was eagerly watched by the Sholagas (the local jungle tribe) on nearby watchman's machans. They hoped that the tiger would kill the pig; and that they would then be able to drive the former off its victim by making a din, and have the pork to themselves! However, our overseer there, and his men in the field camp, heard the row made by the combatants and sallied forth to the spot with torches and, much to the Sholagas' chagrin, drove the animals out of the field!

HONNAMETTI ESTATE,
ATTIKAN P.O.
VIA MYSORE,
27th December, 1950.

R. C. MORRIS

7. JEEP *VERSUS* ELEPHANT

On December 17th 1950 while returning in my jeep at night along the Hassanur-Kollegal road after a final search for the missing ill-fated Air-India plane, I came on a solitary tusker walking up the road tail on, about 30 yards ahead. I immediately stopped, but kept the headlights on and the engine running. Perhaps the sound of the latter irritated the elephant; for it suddenly whipped round and charged. I just had time to put the jeep into reverse, which lessened the impact somewhat. The collision however with such a hard object was not to the elephant's liking and it swung away with a shrill trumpet. Out jumped our dog (Spaniel-Alsatian cross!) which is normally an arrant coward where all wild animals are concerned, and for a few seconds I had glimpses of 'Smoke' (the dog) and the elephant whirling round and round in front of the jeep—to the accompaniment of frantic barks and trumpets—while I endeavoured to retrieve my rifle from the grasp of my driver who, petrified with fear, was quite unintentionally hugging it to himself. By the time I had induced him to release the weapon and loaded it the elephant had left the road; and 'Smoke' was back in the jeep very pleased with himself. I am quite sure 'Smoke' was unaware of the fact that the elephant was a wild one; nor, I feel certain did the elephant know there was an inanimate object behind the dazzling lights he was charging. I was dead tired after days of long tramps through the jungle, and can only assign to this the fact that I was motoring through elephantine forests with an unloaded rifle; I cannot recollect ever having done this before. The impact forced the radiator in, and caused other damage, but I was able to get back to the estate without much trouble.

HONNAMETTI ESTATE,
ATTIKAN P.O.
VIA MYSORE. R. C. MORRIS
27th December, 1950.

8. THE USE OF PATENT BULLETS IN SHOT GUNS

The following will be of interest to users of patent bullets in shot guns with reference to the Miscellaneous Note in Vol, 31, No. 4, pp. 1040/41.

Writing about the Asiatic Two-Horned Rhinoceros Mr. G. C. Shortridge related at p. 774 of Vol, 23, No. 4:—

'It is astonishing how quietly even a Rhino can move when it chooses, as at last without any warning it suddenly crashed out of a bush almost on top of us. As the moon had almost set it was impossible to see the sights of my rifle so I was depending on a shot gun loaded with lethal bullet and dropped him at 7 paces with a lucky shot in the head, which smashed through the zygomatic arch and into the skull, the bullet being afterwards found inside the brain in about a dozen pieces, several of the circular steel discs used in the construction of the bullet having entirely detached themselves from the lead covering'.

BANGALORE, R. W. BURTON,
6th December, 1950. *Lt.-Col.* I.A. (Retd.)

9. MORE BIRD NOTES FROM NEPAL VALLEY

Birds seen in the Nepal Valley during December and January not included in my previous list:

Sitta frontalis: Velvet-fronted Nuthatch. Now quite common on the lower slopes of Nagar Jong.

Garrulax leucolophus: Himalayan White-crested Laughing-thrush. This bird is now very common in large flocks in the jungles up to about 6,500 ft. particularly at Godavari. I never saw them once during

1948-49. As they are so noisy, with very distinctive yelping calls as well as harsh chattering, it seems hardly possible to have missed them and I feel they must have only recently spread into the valley.

Adelura coeruleocephala : Blue-headed Robin. Seen several times on open hill-slopes about 6,000 ft.

Oreocincla dauma: Mountain Thrush. I have often noticed a heavily spotted thrush, always solitary, always on the ground, which runs very swiftly when disturbed and does not fly if it can avoid it. I was never able to identify it for certain. We obtained a specimen on January 13 which proved to be of this species. My husband thinks he has seen it in our garden as late as May.

Bhringa remifer : Indian Lesser Raquet-tailed Drongo. A pair in the jungle at the foot of Nagar Jong. I have heard them there before, but they are scarce in the valley.

Pyrrhula nipalensis : The Brown Bullfinch. A flock seen feeding on the berries of a creeper at 7,800 ft. on Phulchok, January 14. They kept up a soft whistling twitter.

Hypopicus hyperythrus : Rufous-bellied Woodpecker. A female shot on Phulchok at 7,800 ft. on January 14.

Bucia athertoni : Blue-beared Bee-eater. In forest at about 7,000 ft. on Phulchok. Has a curious double croak, rather like the grunt of a monkey.

While we were having lunch on Phulchok at 7,500 ft. we noticed numbers of Phylloscopi (*pulcher* and *proregulus*) drinking the sap of an oak (*Q. semicarpifolia*?). They quite ignored our presence in their eagerness. A pair of Mrs. Gould's Sunbirds often joined in the feast. I tasted the sap which is slightly sweet. This oak does not grow here below 7,500 ft. and from that height to the summit of the hills the bird life is more abundant and varied than anywhere else in the district.

KATHMANDU. (MRS.) DESIRÉE PROUD
15*th February*, 1951.

10. EXTENSION OF RANGE OF THE WHITE-BELLIED BLUE FLYCATCHER (*MUSCICAPULA PALLIPES PALLIPES* JERDON)

On 23rd October 1950 I collected a specimen of the above at Bhimashankar (W. Ghats, altitude ca. 3,000 ft.—19°4 ft. N x 73°32 ft. E). It was in a patch of Government protected more or less primary evergreen forest with an undergrowth of lanky seedlings, typical of its normal habitat in Travancore and the S-W section of the Ghats. Its northernmost limits hitherto recorded were Karwar (Fairbank, *S.F.*, IV. 257 and Londa [Kolez, *J.B.N.H.S.*, **43** (1): 15], both on the Goa Frontier. Bhimashankar is some 250 miles north of these localities.

33, PALI HILL, BANDRA,
BOMBAY, SÁLIM ALI
8*th March*, 1951.

11. WHITE-BELLIED DRONGO CATCHING A BIRD

On 5th February 1951 while camping at Raipur (Amraoti Forest Division, Madhya Pradesh) with Horace Alexander, we witnessed an extraordinary happening. At sunset two White-bellied Drongos were observed hovering purposefully in rivalry around a low leafy twig of a mango tree in the compound of the forest rest-house, as if to stampede some insect lurking amongst the foliage. Presently out dashed a startled Franklin's Wren-warbler which was set upon and hotly chased by both drongos. The warbler rushed into the verandah of the bungalow. Its pursuers followed it there and one of them pounced on it in mid-air, seizing it firmly in its feet like a hawk. With the squeaking victim thus held, it made off pursued closely by the rival for over 50 yards, in and out of the tree tops, until it vanished from sight.

The next day another member of my party, Rainer Brocke, reported a drongo of the same species giving furious chase to a Franklin's Wren-warbler which, however, managed to escape by diving in the undergrowth.

It would thus appear that the taking of small birds by drongos, though I had not myself observed it before, is perhaps less rare an occurrence than the meagreness of records would suggest. Butler (*Stray Feathers,* 8: 500) mentions a drongo eating an iora. Osmaston (*J.B.N.H.S.,* 28: 547) saw one take a white-eye.

33, Pali Hill, Bandra,
Bombay,
8th March, 1951.

SÁLIM ALI

12. THE HEART-SPOTTED WOODPECKER—*HEMICIRCUS CANENTE*

On the data till then available, Peters (Checklist of the Birds of the World, Vol. VI 223/24—1948) gives the distribution of the two races of *Hemicircus canente* as follows:—

H. c. canente (Lesson)

'Assam south of the Brahamaputra, Burma, Malay Peninsula, Siam (chiefly in the lowlands of the eastern provinces) and southern Indochina.'

H. c. cordatus (Jerdon)

'West coast of India from Khandala to Malabar and Travancore'.

Jerdon's sight record from 'the Chanda forest' of over 70 years ago has always been looked upon as probably erroneous since it was never confirmed by later observers. Peters appears also to have overlooked the records from the Bombay neighbourhood (*J.B.N.H.S.,* **42** (1), p. 195—1940), and since then the distribution on the western side of the peninsula has been extended still farther north to the Tapti river (ca. 21° N. × 73° 40 ft. E.) by a fine series collected by the Gujarat Ornithological Survey in the Surat Dangs and Navsari Prant of Baroda. More recently still the Bastar and Orissa Ornithological Surveys discovered this little woodpecker on the eastern side of the peninsula (approx. between lat. 19° and 22° N. and long. 81° and 86°).

The named population of south-west India (separated from nominate *canente* only on smaller size of wing and bill) hitherto believed to be isolated from that of Assam, etc., now proves to be merely the south-western extremity of a continuous chain of distribution which, as in the case of so many other bird species, stretches across the peninsula over the Satpura axis. The gap from Orissa to Assam remains to be bridged, but this is no doubt only a matter of time and methodical collecting.

Under the circumstances I am unable to see the justification for retaining any longer the 'Malabar' race *cordatus*. The separation was due solely to insufficient knowledge of the species's distribution at the time. The populations of the Dangs and Bastar do show a slight average increase in size of wing and bill over that of the Travancore area, but this is a gradual cline and such as would normally be expected under Bergmann's well-known rule. There is no difference in colouration.

Comparative measurements are given below:—

	Wing	Bill	Tarsus	Tail
Travancore, Wynaad and N. Kanara (B.N.H.S. Collection) :—				
4 ♂♂	94–98 (95·25)	18·5–22·5		
7 ♀♀	86–93 (90·3)	18–19	—	—
*Surat Dangs**.				
5 ♂♂	93–99 (95·6)	20–22·5	18·5–19·5	33–35
4 ♀♀	92–94 (93·5)	19·5–21	17·5–18·5	32·5–34–5
Bastar and Orissa *:				
2 ♂♂	97–99·5 (98·25)	22·5	18·5–19	34–37
2 ♀♀	95–96 (95·5)	19–20–5	17·5–19	33·5–38
Assam, etc., (vide Fauna iv, p. 84)				
♂♂	94–103	20–25	17–19	28–31
♀♀	92–98 (one 89)	19–21		

As it is impossible to define the exact geographical limits of either race owing to the continuous distribution, I propose that the race *cordatus* be suppressed after suitable indication has been given of the existence of the cline in size from Travancore to Assam, etc.

33, PALI HILL, BANDRA,
BOMBAY,
8th March, 1951.

SÁLIM ALI

13. DISCOVERY OF THE SO-NAMED 'MALABAR' BLACK WOODPECKER [*DRYOCOPUS JAVENSIS HODGSONI* (JERDON)] IN BASTAR (EAST MADHYA PRADESH).

The distribution of the Great Black Woodpecker given in the Fauna (Vol. IV, p. 90) is 'Travancore to Belgaum, on the Western Coast of South India'. In 1941, Humayun Abdulali (*J.B.N.H.S.*, 42: 933) by recording it at Suriamal on the southern border of Nasik District extended its distribution considerably northward. The Gujarat Ornithological Survey extended the distribution still farther north by collecting specimens in the Surat Dangs and Navsari Prant of Baroda, almost to the Tapti River (ca. 21° N. x 73° 40′ E.). There is an old specimen (♀) in the British Museum collection labelled 'Khandesh', without other data, which seems to have been completely ignored by previous workers.

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* Measured in the flesh.

One of the surprises of the Bastar Ornithological Survey was the unexpected meeting with this woodpecker on the eastern side of the peninsula at Amraoti (19° 35′ N. x 81° 58′ E.). Only a single pair were seen in fairly dense moist deciduous forest—the typical habit of the species—and the female secured on 28-12-1948.

I have compared this specimen with material from south-western India in the collections of the Bombay Natural History Society and the British Museum, as well as with the fine series recently obtained in the Surat Dangs, and can see no difference in colouration.

Comparative measurements are as follows:—

	Wing	Bill	Tarsus	Tail
*Bastar**				
1♀	222	61	36	164·5
Travancore and Kanara (in Bombay Natural History Society's and British Museum's collections):				
10 ♂♂	215-223 (218·1)	...	...	143-162 (156·6)
5 ♀♀	212-221 (215·4)	...	...	130-170 (156·0)
*Surat Dangs**				
6 ♂	213-225 (219·17)	63-69	37-43	139-165 (153·5)
6 ♀	214-219 (216·17)	59-65	36-39	135-161 (149·0)

Thus it appears that there is no appreciable difference in size either, though it is of course possible that following the normal rule, eastern birds in series *may* average somewhat larger as seen in the case of the Heart-spotted Woodpecker (*Hemicircus* canente).

The occurrence of the Large Black Woodpecker at either extremity of the Satpura axis, and the almost identical nature of the two populations, suggests that the species may be continuously distributed over this entire mountain trend in enclaves of the appropriate biotope and emphasizes the need for careful investigation of the intervening blank area whence it has so far not been recorded.

33, Pali Hill, Bandra,
Bombay,
8th *March*, 1951.

SÁLIM ALI

14. AN ALBINO SNIPE

You may be interested to hear that when shooting to-day near a village called Krishnapur, in the Salt Lakes outside Calcutta I put up a pure white snipe. It got up close to me and had I not been so surprised, I should have shot it. It uttered the usual snipe 'scaping' noise and flew round in the usual way, unfortunately going out of sight before pitching.

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* in the flesh.

In 18 years' shooting in India this is the first albino snipe I have ever seen. My shikari had never seen one before in his life. I should be interested to learn of similar instances, and as to the degree of their frequency.

20, Alipore Road, H. M. MOLESWORTH
Calcutta.

[Three other cases of albino snipe have been recorded in past volumes of this journal. The *Journal* also records albinism in such diverse animals in India as the following:—

Mammals.—Tiger, elephant, blackbuck, kakar, hog-deer, gazelle, chital, sambar, wild boar, palm squirrel.

Birds.—House sparrow, hoope, crow, shoveller, comb duck, Malay spotted dove, Nilgiri pipit, chukor, red-vented bulbul and rufous-backed shrike.

Since going to press we have received through H.H. the Maharao a pure albino Black Partridge (*Francolinus francolinus*) recently shot in Kutch.—Eds.]

15. EXTENSION OF BREEDING RANGE OF THE STILT (*HIMANTOPUS H. HIMANTOPUS*), AND SOME NOTES ON ITS HABITS AND PLUMAGES

In our paper on the Birds of Bombay and Salsette in 1939 (*J.B.N.H.S.* 40: 639) we recorded the Stilt as 'Not uncommon but patchily distributed', with all our records between 29th September and 6th November only. We also tentatively listed it as 'a local migrant'.

In April and May 1944 we saw many birds in Mahim Creek and I have a note for this area dated 9th June 1947:—

'Flock of 40 to 50 birds has been here for over a month—appear restive—stretching wings over back and bickering, but not making up their minds to go.'

With the sustained restriction on the use of firearms within city limits during the last few years, stilts together with many other waders such as black-tailed godwits, avocets, sandpipers and large numbers of duck have frequented this area, and despite the stench an interesting hour may be spent here watching a galaxy of water birds.

On 4th June 1950, the water level at Powai Lake (which is a few miles north) had dropped very low creating several new islands, and here one or more stilts uttering the alarm call of 'wik-wik-wik' very loudly when approached, were noted. On the 11th June only a single pair was left and one bird was seen squatting five yards from the shore on a bare island about 25 yards long and 15 yards wide. A crocodile lying on the water's edge, five yards away, did not appear to worry it very much. A couple of days later I got to the islet with a boat and a stilt was put off 4 eggs arranged plover-like (small ends pointing inwards) on a thin layer of small pebbles. On the 23rd June two young in down were running about the island while one egg on the point of hatching was still in the nest.

The young swam well and one was seen to return after a short trip on the lake. A few days later the birds had shifted to a larger island which held a considerable amount of vegetation and one lanky full-fledged chick was discovered here after a long search. This bird had got its legs tied together by a piece of white 'string' which prevented it from walking normally. For a moment I suspected that some amateur photographer had also discovered the birds and this was an attempt to keep it within range of his camera. There were, however, a large number of cobwebs on the island and an examination of the 'string' by Fr. Santapau confirmed that the bird had hobbled itself accidently with these. When released, it swam away and managed to evade capture from a boat for a considerable period. The parents were greatly agitated, using both the 'wik-wik-wik' and a continuous and grating cry uttered from the ground. They also settled on the water when our presence on the island prevented them from landing there.

Stuart Baker, both in Nidification and the Fauna, implies that stilts nest all over India, but except for Ceylon there are no records south of Sultanpore, near Delhi. (K. S. Dharmakumarsinhji of Bhavanagar, in a recent bird film showed them nesting at Porbandar in Kathiawar).

In the 'Handbook of British Birds' Volume 4, page 406 is a picture of a stilt with a black head marked '*Adult male*: *summer*'. The Handbook adds that in summer the male has the underparts suffused with a roseate tinge and the crown and nape more or less black with variations in the following groups:—

(*a*) With crown down to below eye and nape black (forehead and lores white).

(*b*) As (*a*) but crown and region behind eye usually intermixed with white, nape intermixed with white or with white feathers tipped black.

(*c*) Crown white, hinder crown intermixed with black, feathers of nape white, sometimes tipped black.

The Fauna (vi, p. 193) describes the adult male as having a white neck and head with a few black spots often showing on the head. There is no reference to a winter and a summer plumage. It also says that young males have the anterior crown, upper ear-coverts and a line down the back of the neck black. This is questioned by Ticehurst (*J.B.N.H.S.*, **34**: 486) who considers this either sub-adult or a variation. The Fauna adds that the female has the white head always sullied with some grey, as also the hind neck.

Whistler in Avifauna of Ceylon p. 277 described a new race, *ceylonensis*, from Kalawewa, Ceylon, whence 4 breeding males are in the British Museum. 'The males differ from the typical form, which *has the crown and nape black in the breeding plumage*, in having those parts white merely sullied by the dark bases of the feathers showing through. The females have the brown back darker than in European birds'.

Both parents at Powai were glassed at close range and appeared to have pure white heads and necks except for slight traces of very light grey on the hind neck. There was certainly no black on the **crown** and/or nape of either parent.

I have also seen many photographs of stilts at their nests and they invariably show pure white heads e.g. in Coward: Birds of the British Isles Vol. III p. 20, Lowther: A Bird Photographer in India p. 131, K. S. Dharmakumarsinhji of Bhavanagar's cine film.

Subsequent to the above observations I noted a party of 4 birds on 7th September in which the male (with black wings) had a pure white head while two birds with brownish wings had brown heads. Further notes for October, November and December record that the heads appeared to be darkening and no birds with pure white heads were seen. All this appears to confound Whistler's description of his race *ceylonensis* somewhat, and it would be interesting to obtain further observations on the plumages of this relatively common species.

c/o Faiz & Co.,
75, Abdul Rehman Street, Bombay, HUMAYUN ABDULALI
15*th January*, 1951.

[The photograph of a stilt at nest on page 36 of G. K. Yeates's book 'Flamingo City' (reviewed at p. 768 of this number) depicts a bird with a blackish nape. Amongst a gathering of over 150 non-breeding stilts observed at Dharavi Creek (Bombay) on 15th February, 1951, only a single bird had completely white head!—Eds.]

16. MASS MOVEMENT OF PELICAN

On a dull wintry day, about the month of January 1935, while I was camping at a place called Chargharia on the south bank of the Brahmaputra River in the Kaziranga Game Sanctuary in Assam, I noticed flocks after flocks of pelicans coming from an easterly direction and settling on the shoal and sandbank opposite my camp. This went on for hours. Such a huge congregation of birds of the size of pelicans was an unusual sight for me. Even modestly computed the number would certainly exceed one thousand.

My companions, two local villagers whom I had engaged as boatmen, offered the information that they too had never seen so large a congregation of pelicans. To satisfy my curiosity, I rowed across the river (which was about a mile wide here) to the spot, and when I got close enough I saw quite a number of Brahminy ducks and geese also in the midst of the birds. They all seemed to be standing still 'doing nothing'.

The first to take to wing were the Brahminy ducks. The pelicans ignored my advancing boat for some time, but gradually rose in waves, flew pell-mell in all directions for a while and finally made off towards the east.

Neither the Sanctuary, nor the country around it is known to be a habit of pelicans, nor do they nest there. They are of course occasionally seen in small flocks of 5-10 on shoals in the river.

I wonder, what could have been the occasion for such an unusual congregation—unusual at least for this part of India. May be they were migrating, but I failed to see anything of them afterwards although I was camping there for the next few days.

Makum, D. NEOG,
Assam. *Assistant Conservator of Forests.*

17. A SUNDERBAN HERONRY

During my trip to the Sunderbans (Khulna) in early August 1944, arranged by courtesy of the Divisional Forest Officer and accompanied by Mr. M. Sain, artist and naturalist, I had a unique opportunity of visiting what is called 'Chunkuri Block', covering a huge area of typical Sunderban tree forest, which at this season provides an enormous nesting colony for heterogeneous groups of birds. Leaving Khulna town on August 2 after lunch, we halted the night in the *Aura Sipsah* and reached this spot next evening at 8.30 p.m., via Cobaduk and Buri-goalini forest-stations. At daybreak we got into jolly boats and wended our way through mazes of nullahs, shallow creeks and water channels underneath dense patches of forest trees. It did not take us long to reach the proximity of what was obviously a natural bird sanctuary but whose integrity and sanctity were maintained by the forest authorities. As we drew closer, we were struck by the grandeur of the scene—a vast stretch of evergreen swamp forest of Sunderban trees, some dwarfish, others taller and sometimes luxuriant, others again with tops bare of leaves, all entirely colonized by a huge mixed gathering of nesting birds. The species most noticeable were *Anastomus oscitans* (Bodd.), *Egretta intermedia* (Wagler), *Egretta garzetta* (Linn.), *Bubulcus ibis coromandus* (Bodd.), *Nycticorax nycticorax* (Linn.), *Phalacrocorax niger* (Vieill.) and *Anhiga melanogaster* Penn. Remarkably enough the Open-bill Storks (*A. oscitans*) and one or other of the three species of egrets mentioned above had their nests in the same tree, either 'Khalshi' (*Ægiceras majus* Gaertn.) or 'Kankra' (*Bruguiera gymnorhiza* Lamk.), which is generally of low stature. Some taller trees like 'Keora' (*Sonneratia apetala* Ham.) and 'Baen' (*Avicennia officinalis* Linn.) apparently had great attraction for the Open-bill Storks. I observed the birds at close range picking and plucking leaves and stems from their tops, and in many instances I found their nests built in the forks of these trees and composed entirely of such plucked leaves and stems. There were egrets' nests also on these trees and I likewise observed some Night Herons (*Nycticorax nycticorax*) nesting on them. One striking feature in the biology of these community-breeding birds was that while *A. oscitans* nested freely in the company of *Egretta intermedia, Egretta garzetta* and even *Bubulcus i. coromandus* it seemed to give a wide berth to *Anhinga melanogaster* and *Phalacrocorax niger* whose nests were placed apart, though not infrequently in proximity of egrets' nests. The one or two nests of *A. oscitans,* which was the normal number built on a single tree, were invariably surrounded by a large number of egrets' nests—either almost exclusively those of the Cattle Egret or by a mixed assemblage of those of the Little and Cattle Egrets and even *E. intermedia.* In a few cases I also saw nests of *Nycticorax nycticorax* in this assemblage. *Anhinga melanogster,* a prominent breeding species in this colony, was generally found to affect very tall 'Baen' trees. On one of these trees I saw a pair mating.

The number of birds in this breeding congregation was so enormous that no satisfactory estimate was possible. From our jolly boat passing through the narrow nullahs and water channels thickly overhung with foliage and hemmed in by dense tree forest it was not possible to get a full or comprehensive view of the scene. From my casual survey it was apparent that though nesting activity was brisk and most, if not all, of the birds present were taking part in it—yet there were only a few nests which had eggs in them. A few nests already contained some young in different stages of growth—from one just hatched to a fledgling. The parent birds on our approach showed hardly any reaction except to move away some distance on our attempting 'close-up' photos. The presence of crows and kites near the nests, though no doubt a potential danger to the eggs and nestlings, curiously enough did not seem to perturb the parents at all, the Open-bills in particular showing utter indifference to them. Apparently the boldness and tame and confiding nature of the birds are due no less to their colonial instinct, strikingly brought into play now under impulse of breeding, than to the comparative immunity enjoyed by the nests due to their location in this almost inaccessible Sunderban swamp forest subjected to the perpetual influence of the tides.

CALCUTTA, SATYA CHURN LAW,
29th August, 1950. M.A., PH.D., F.N.I.

18. EFFECT OF THE ATMOSPHERIC PRESSURE ON FISH

In the April, 1950 issue of the *Journal* (Vol. 49, p. 128) Mr. E. P. Gee reported on the effect of atmospheric pressure while fishing. His observations confirm what is well-known to many anglers in all parts of the world, namely that fish do react intensively to changes in atmospheric pressure, much in the same way as they do to a change in water pressure following a rise or fall in the water-level.

It is generally accepted that fish are active and on the feed when the pressure (atmospheric or water) is high and decline to feed and become inactive when the pressure is low when they also move to the bottom or deeper water to counter the lowered pressure. This has been observed by me on many occasions. In addition, it cannot be over-emphasized that fish become greatly disturbed, if a considerable change in pressure takes place *suddenly*. Then it does not matter whether the pressure is up or down. Upon such sudden change, fish become very uneasy and disturbed for hours, and sometimes days, until they get accustomed to the changed conditions.

Whether a change in atmospheric pressure has the same effect as compared with the much stronger change in water pressure is not quite certain. No doubt, when fish move up by a few feet from deeper water towards the surface or vice versa the pressure change which they must register is much larger than the most violent change in atmospheric pressure, and therefore the fact that fish do at all react to atmospheric pressure can only be explained by the very sensitive organs which fish possess, namely the lateral line and the bladder. Both organs seem to be very delicate pressure instruments. Whether the ear (which is built quite similarly to the ear of mammals) is also able to register pressure changes is not known.

The new theory of 'SOLUNAR' reactions and periods, as given in the Solunar Tables, published by J. A. Knight in U.S.A. and now reprinted regularly in some 80 American Outdoor magazines and other papers, does not quite fit into our old observations on atmospheric pressure. This new theory is based on the presumption that animal (including fish) life is under the influence of sun and moon radiation (Sol = sun; luna = moon) and the position of sunspots during the earth's 24-hours course. If there is any reaction from Solunar radiation and the constellation of sun and moon upon atmospheric pressure, then it can only be due to the fact that there is some interconnection with the low and high tide of the atmosphere, similar to the ebb and flow of the sea. This phenomenon which has been known for some years is called 'Atmospheric Tides'. Attraction and heat radiation from sun and moon cause pressure waves in the atmosphere rotating with the earth. Such regular periodic pressure waves are observed and registered with a sensitive barometer. The most important pressure waves from the sun travel round our planet once every 24-hours. It can be very distinctly observed in the Tropics by direct reading from a barograph.

Atmospheric tides caused by the moon are comparatively insignificant, oscillations being very minute. I mention this, because it is often reported that fish bite better or less during moonlight or full moon. I believe that this is not the result of atmospheric influence, but probably due to the fact that fish have a better chance to see and find their food.

As to the 'incident' in connection with the Black Mahseer reported by Mr. Gee, I regret I have no explanation to offer. It should be observed that other circumstances, besides atmospheric pressure, are of importance, particularly in river fishing, e.g. water temperature and discolouring, periodic appearances of different insects, larvae and other food on which different fish feed.

BOMBAY F. R. GOLDSCHMIDT, D.SC.

19. EFFECT OF ATMOSPHERIC PRESSURE WHILE FISHING

With reference to my previous notes on this subject, published in the *Journal* of August 1949 and April 1950, I was in Britain on leave in 1950 and made further enquiries about the theory of atmospheric pressure making a very great difference to the feeding habits of fish.

Dr. Edward Hindle, F.R.S., of the London Zoological Society referred me to the Solunar Theory, in which he appeared to believe. This theory is fully explained in *The Modern Angler* by John Alden Knight (Charles Scribner's Sons Ltd., New York and London, 1936), and claims that 'other conditions not being unfavourable, fresh-water fish tend to feed more readily during Solunar periods than at other times.' The Solunar period is 'the time at which the conditions which cause ocean tides (i.e. the pull of the sun and the moon) pass the longitudinal meridian of any given point.'

In order to put this Solunar Theory into practice, it is necessary for those fishermen who live inland to find out the high and low tide times of the nearest *true ocean tides*. Then adjustment must be made according to the longitudinal difference (geographically) by the formula

15 degrees of longitude equals 1 hour of sun-time. It is claimed that the best results are to be had when fishing during the Solunar period corresponding to low tide, the effect on the fishing at high tide being not so marked.

It is claimed that the Solunar Theory has worked well in the U.S.A., and that the Solunar periods of practically all the inland fishing resorts have been worked out in detail and published. I do not know if it has been tried out in India—if not, then there is a good opportunity for someone to test the theory in this sub-continent. But I was gratified to read in the above-mentioned book that the author admits that 'fluctuations in barometric pressure are perhaps the most common and decisive influence on the daily habits of fresh-water fish.' And he goes on to give the following barometric causes and effects:

'Rising glass—good fishing.
Steady glass high—fair fishing.
Steady glass low—fair fishing.
Falling glass—poor to very bad fishing.'

On my enquiring, while in Britain, as to who was the person most eminently qualified to give me an opinion on my own interpretation of the effects of barometric pressure on fishing, I was recommended to contact Professor James Gray of Cambridge University. Professor Gray in addition to being a noted zoologist and a Fellow of the Royal Society is also himself a keen fisherman. I herewith give, with his permission, an abstract of his letter to me on the subject:

'I am very much interested in the possibilities that changes in atmospheric pressure may affect the behaviour of fish. The same suggestion was made by W. H. Macaulay who used to fish the Add in Argyllshire. His idea was that a sudden rise in the barometer was a good omen for catching salmon and sea trout. From a physiological point of view, it is reasonable to assume that the fish could detect such a change by means of its swim bladder—provided the *rate of change* of pressure is sufficient. On the other hand, a change in pressure might, in the case of trout, affect the fish by influencing the hatch of insects etc.

'To test the theory it would be necessary to keep very careful records for a considerable period of time—being careful to record: (1) changes of barometric pressure which *were* accompanied by good fishing, (2) similar changes which were *not* followed by good fishing, (3) whenever fishing is good—a record of barometric changes would be necessary and finally (4) when fishing is poor, what is the barometer doing? Without data of this type—there is danger of selecting occasions favourable to the theory and ignoring others.

'Your suggestion is, without doubt, an extremely interesting one, and is well worth following up.'

It appears, then, that the keeping of records of barometric changes while fishing is likely to be of very great use to all those sportsmen who indulge in the 'gentle art'.

Doyang T.E.,
Oating P.O.,
Assam.
13th January, 1951.

E. P. GEE

20. STINGS BY THE COMMON INDIAN HORNETS *VESPA ORIENTALIS* AND *VESPA CINCTA*. SEVERE EFFECTS

It is not perhaps generally known how very severe may be the symptoms and effects following stings by the two species of common Indian hornet, the smaller being *Vespa orientalis* and the larger *Vespa cincta*.

In the Society's *Journal* Vol. XVIII, No. 3. of 15th July 1908 there is record of three cases among Indian troops at Peshawar occasioned by the smaller hornet. These effects, while sufficiently severe—semi-consciousness, cyanosis, fainting, contracted pupils, shallow respiration, feeble and irregular pulse, blue lips, rise of temperature—were much surpassed by the effects of four stings on scalp and neck of an officer out shooting in Kumaon on 10th December 1908 as recorded by Major F. Wall, I.M.S., at page 533 of Vol. XIX, No. 2. Major H., attacked by hornets, lay down and protected his face with arms round his head thus exposing only the back of head and neck to the stings. In about ten minutes he became unable to speak and fainted away. His face became livid, eyes bloodshot, nose and ears blue, hands cold and blanched, pulse not discernible.

On recovery from semi-consciousness, which lasted about half an hour, he was unable to see. He suffered an intolerable itching all over the body and a rash appeared all over the abdomen. After some rest he was able to walk to camp, with assistance. Severe diarrhoea set in about 7 p.m. and lasted all night. Genitals became oedematous but not painful. Next morning he was able to continue shooting and there were no further untoward symptoms.

Major Wall remarked on the case:—

'The poison appears to have operated in two ways. Firstly upon the nervous system, and the full force of the neurotoxic agent appears to have fallen upon the heart. There appears too, to have been a toxic influence reducing the coagulability of the blood, hence the rash, which was probably a nettle rash, and the oedema of the genitals. There seems little doubt that had one or two more stings been inflicted the case would have ended fatally.'

In spite of repeated efforts a specimen of the hornet was not obtained for identification. In view of the following account it may have been *V. cincta*.

The Peshawar cases were treated with strychnine, hot water bottles, etc. There is no record of treatment in the Kumaon case.

I am moved to refer to the former cases—no others have been reported in the *Journal*—because of the case now related to me by Mr. A. E. Lobb of the Mavinkere Estate, Mysore.

STINGS BY *Vespa cincta*—DEATH OF A DOG

A hornet's nest about the size of a Rugby football and attached about three feet from the ground to a branch of a fallen tree had been passed many times, being close to a path. On 6th October 1950 Mr. Lobb was following behind his mechanic and another man, his cocker spaniel at heel. Suddenly the party was attacked; the men ran away and the dog ran all over the place, yelping with pain. Mr. Lobb stood quite still, and only because he had to move his right arm to steady on his walking stick (he is very lame) did he receive two stings on right elbow. In a few minutes he followed after the dog to the bungalow. He had at once realized that immobility would be his sole protection.

The dog did not cry out any more but stood, rigid and panting heavily. He could not, or would not, lie down and remained standing until the 8th when he fell and died. All the time he could not open his mouth or drink. Water was poured down his throat. He performed no natural motions except on the second day when he passed urine the colour of black coffee. There were no signs of stings or swelling inside his mouth or on the tongue.

The mechanic had four stings on the head and two on the arms. After about an hour he became unconscious and so remained for about two hours. Then diarrhoea commenced and lasted about twelve hours. About three hours after the diarrhoea commenced he vomited a great deal and had cramping pains in the stomach. Neither temperature nor pulse were taken. Sight did not appear to be affected. By 10th October he had recovered.

The doctor who came on the 9th was unable to suggest any treatment as necessary. He said that there was record at his hospital of a man who had died as result of twelve stings by hornets, species not named. Mr. Lobb's arm swelled and elbow became very stiff and so remained for about a fortnight. There was, at first, an intolerable itching of the part. Both stings were on the bare elbow.

It is difficult to understand why the dog suffered no bowel effects At page 275 of Vol. 28 is an account of a big, smooth-haired fox terrier dog being stung by a scorpion. The effects were very severe and after an hour the dog was sick, and continued vomiting until his stomach was empty. Later he passed a lot of blood per rectum. Perhaps it was, in case of the cocker spaniel, that the stings were many, and the weight of the dog being about one-sixth that of the man the intestines became rigid and unable to act. Had the dog been able to vomit and also empty his bowels he might have recovered?

These cases of hornet sting indicate how very dangerous to life they can be, and that in the absence of a blanket or such covering complete and instant immobility is the only protection.

BANGALORE, R. W. BURTON,
16th January, 1951. *Lt.-Col.* I.A. (Retd.).

21. A BUTTERFLY (*CATOPSILIA CROCALE*) WITH A DEFECT IN RIGHT HIND WING

On 10th June 1950 a male of the above named species, (specimen in question has been despatched in a separate parcel) attracted attention because it was noticed that the right hind wing was spotted and discoloured. It was netted whilst feeding on the orange coloured flowers of Lantana scrub (*Lantana aculeata*).

Examination under an 'Ultra Lens' (Indian distributors:—Hardcastle Waud & Co., Ltd., Bombay) shows the following abnormal features—the under- and upper-side right hind wing exhibits a distortion by curling outward of the wing and in the depression created, the scales, in the interspaces of nervules 1, 2, 3, and 4, are discoloured by a brown and melanin black substance overlaid. In the cell there is one spot (near to the discocellular vein) which under magnification appears as a knotted mass of the melanin pigment substance superimposed on and obliterating the scales. One other similar spot lies at the junction of nervule 3 with the median vein. Between the dcv and extended up to the termen the discal area is stained brown and nervules 3 and 4 for their entire lengths are stained black and brown and interspersed with black nodules, similar to the spots alluded to in the foregoing. The left hind wing, on its upperside, shows similar discolouration on a section of it corresponding to and impinged upon by that of the rot on the right hind wing—close apposition of the wings occurring when the fly, is in the resting posture at night, and while feeding. Owing to infiltration of the substance through the left hind wing a slight discolouration on its underside is visible to the naked eye.

The question arises as to whether the defect is a congenital malformation or due to a mycotic infection acquired after emergence. The normal greenish yellow tinge has, in the decayed parts, been slightly bleached. Nervules 3 and 4 show marked distortion and a black-rot involvement. All these unusual features—and more particularly because the nearly sound left hind wing is becoming infected with the rot—serve as pointer to the condition not being a congenital defect, but rather, a mycotic infection. I haven't a microscope to examine the scrapings in order to ascertain whether mycelium threads and sporangia are present. The moulds, which often cause trouble to collectors and damage to dead specimens kept in envelopes and cabinets, are different and in the nature of fur growths. In this example the wing-rot in a living imago, if not due to a fungus, is certainly a diseased condition of some kind, possibly of the wing membranes, causing destruction to the structures, which might ultimately lead to its dysfunction. It should be noted that the flight seemed normal. The tear in the defective wing must have occurred owing to extreme fragility resulting from the abnormality when the fly was fluttering in the net. With a normal fly of this species the wings usually do not become easily damaged by the net. During 14 years of collecting butterflies this is the first example met with of a deviation from the normal. Butterflies with shattered wings are often encountered in the free state—a disintegration caused by age and trauma. The disability here recorded must be rare amongst the Order Lepidoptera.

In Volume 48 No. 4, p. 814, Mr. T. Norman, in his 'Note on the Larva of *Amblypodia centaurus*' cites examples of mould infections. He makes a reference to the remarks made thereto by Mr. D. G. Sevastopulo in his paper Some Suggestions for Entomological Work in India (Vol. 48, No. 1, p. 81) that 'as yet, no Indian Lycaenid larva is known to be unable to survive by reason of the honey gland becoming choked with mould if the attendant ants are removed.'

The suggestions made by Mr. D. G. Sevastopulo in his paper have prompted me to submit this note. You may retain the specimen and deal with it as you think fit.

A. G. L. FRASER,
Capt., I.M.D. (Retd.).

DANDELI,
NORTH KANARA.

[Through the good offices of Prof. G. Hale Carpenter of Oxford University to whom the specimen was submitted, we have obtained the opinion of Dr. G. C. Ainsworth who kindly got the mould into culture in order to identify it.

Dr. Ainsworth writes:

'The butterfly fungus is proving troublesome . . . . it is undoubtedly a species of *Aspergillus* but I cannot be specific. In 1879, M. C. Coote (? Cooke) described an *Aspergillus* which he obtained from the pupa of an Erie silk moth from Cachar, and there are a few other records of *Aspergilli* damaging insects. The present one does not seem to agree with any of these, nor with any other good species of *Aspergillus*. It grows *very* slowly, and the conidial heads are mostly what I take to be malformed. . . . . . . All I can say at present is that the fungus is a species of *Aspergillus* which is possibly undescribed . . . . . . If I make no more progress I will send a culture to an expert in the groups in U.S.A.'

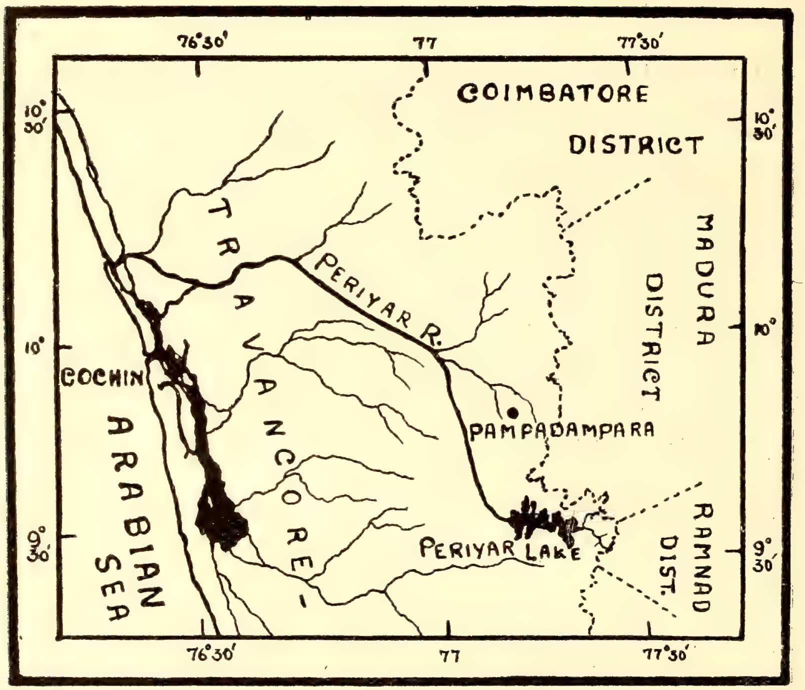
A further communication is awaited with interest.—EDS.]

22. ON THE OCCURRENCE OF THE FRESHWATER MEDUSA, *LIMNOCNIDA INDICA* ANNANDALE, IN THE WESTERN DRAINAGE OF THE SAHYADRIS

(*With a text map*)

While recording in the August 1950 issue of this journal (Vol. 49, p. 318) the occurrence of *Limnocnida indica* Annandale from below the Jog falls in the Sharavati river, Ramakrishna and others (1) were evidently not aware of the fact that *Limnocnida* was already recorded from the western drainage of the Sahyadri by Darling (2) in 1935. In pointing out the significance of the find in a water system flowing westwards she said 'It is noteworthy that freshwater medusae were found by Dr. S. P. Agharkar, but were in a river system which flows eastwards across the continent and enters the Bay of Bengal'. Though her provisional identification of the medusa stopped with the genus, it is unlikely that it could be any species other than *L. indica*. The medusa was collected by Darling from the Periyar Lake, Travancore, which is formed by the construction of a dam across the Periyar river which flows westwards into the Arabian Sea (sketch-map). The water stored in the lake is diverted to the Madura District for irrigational purposes, along a tunnel through the Western Ghats.

A still more interesting but yet unpublished record of *L. indica* from the western drainage of the Sahyadris is its collection by Mr. G. Renga Aiyer of Trivandrum in 1944 from a stagnant tank at Pampadampara Estate in the Cardamon Hills, Travancore, about 20 miles north of the Periyar Lake and lying within the Periyar watershed (sketch-map). So far as I know he did not record the collection probably in view of the note by Darling (2) on the occurrence of the medusa within the same watershed. For about 2 years, from 1940 to 1942, I was stationed at Pampadampara, but the presence of the medusa did not come to my notice though I made fish collections from the tank several times. I have seen the material collected by Mr. Renga Aiyar and this consists mostly of large specimens, but cannot give from memory any further details. He told me that collection was mainly done by disturbing the surface by pouring bucketfulls of water which helped the medusa to come up in the eddy that was formed.



The Pampadampara tank, situated at an altitude of about 3,000 feet, is an artificial one, roughly oval in shape, about 120 feet long and 90 feet broad and formed by the construction of a small bund at the head end of a narrow ravine near the estate quarters. The water in the tank is intended for the labourers, for bathing purposes, and is used by cattle also. There is no stream flowing into the tank and it depends entirely on the rainwater washed down from the sides. The depth is about 5 feet during summer and 8 feet during the rains, and the bottom is soft mud. In summer there is no outflow from the tank and the ravine below is dry while during the rainy months the excess water flows out into it through a small drain pipe. This tricklet flows into other streams lower down that ultimately swell into one of the main tributaries of the Periyar river, which it meets about 35 miles below the dam.

The Pampadampara tank is different from other pieces of water from where *Limnocnida* has been recorded hitherto in that it does not lie in the regular course of a river. There could be little doubt that the medusa came into the tank after its construction some years ago. The agency responsible for its introduction could at present be only a matter of speculation. If a resting stage, as suggested by the previous workers (3), actually exists there is chance for its fortuitous distribution during this phase of its life-history. A further point of interest in the occurrence of the medusa in the Periyar watershed is that this region lies in the southern section of the Sahyadri range which is separated by the Palaghat gap into a distinct zoogeographical zone. A systematic survey of the distribution of the medusa and a study of its life-history should yield interesting results.

CENTRAL INLAND FISHERIES RESEARCH STATION,
BARRACKPORE, S. JONES
15*th November,* 1950.

REFERENCES

(1) *J. Bombay Nat. Hist. Soc.*, 1950, **49** (2) : 318-319.
(2) *Nature*, 1935, **135** (3404) : 151.
(3) See (1) above for the previous references.

23. NEW RECORD FOR *FREREA INDICA* DALZ. IN BOMBAY PROVINCE

In this journal (**41** : 143, 1939) C. McCann, formerly the Curator of our Society, published a very complete and illustrated description of this plant. According to McCann, the plant had been seen three times in Bombay Province, and in every case either on Junnar Hill, Poona Dt., or in its immediate neighbourhood. Recently I found it at Purandhar, Poona Dt., at an altitude of about 4,000 ft., on the slopes just below Vazirgarh Fort, the twin fort of Purandhar.

At first sight the plant looked to me like a somewhat stunted and irregular stem of *Euphorbia neriifolia,* but for the absence of thorns and the regular arrangement of the leaves, that seemed to be opposite, to judge from the leaf scars. After a week of keeping the plant on the floor of my room in Purandhar, I brought it down to Bombay and planted it in my laboratory. In a week's time the plant brought out several leaves, and on December 20th 1950, it opened its flowers; these are so typical that I have no doubt about the identity of the plant.

Purandhar, then, is to be considered a new locality for this very rare plant. At the same time, judging from my experience, it is quite possible that *Frerea* is not so rare as it appears, but its great similarity with *Euphorbia* when in leaf may have caused some collectors to mistake one plant for the other and to leave untouched what they considered a very common plant. In my case it was almost an accident that the plant was collected and planted for further study.

St. Xavier's College,
Fort, Bombay 1. H. SANTAPAU, S.J.
22nd December, 1950.

24. A NOTE ON THE OCCURRENCE OF TURIONS IN *HYDRILLA VERTICILLATA* PRESL.

(*With a plate*)

The turions or winter buds are well known to occur in a closely allied species *Elodea canadensis* Michx. (1), but those of *Hydrilla verticillata* Presl., as far as I am aware, have never been described. Although the turions of *Hydrilla* in several respects resemble those of *Elodea* (1, 2), there are certain very marked differences which call for some remarks. The species, on which the present study is based, grows abundantly in stagnant pools round about Annamalainagar, often mixed with *Elodea.*

The plant is benthos-rooted to the bottom of the pools. It has a linear branch (fig. 1, *m*) which trails inside the muddy substratum. Branches arise in an axillary position from a condensed shoot which itself is borne in the axil of a leaf of the main trailing axis (fig. 15, *v.* 1). These branches grow erect and remain lashing in water (fig. 1). Their lower internodes are longer than the distal ones. At the nodes leaves are borne in whorls of four to six (fig. 1).

On the approach of winter the condensed shoots, which bear the normal vegetative branches, give rise, from the axil of the scale leaves, to positively geotropic shoots which penetrate into the muddy floor of the pool (fig. 1, *t.s.*; fig. 15, *t.s.*). The apices of these shoots then swell up to form turions. The turion is boat-shaped (fig. 2), and sharply curved at its distal end, and is white or whitish brown in colour.

It is interesting to note that such turions are also formed on the erect stem far above the mud-level (fig. 1, t_1 and t_1). These turions are either sessile (fig. 1, t_1) or stalked (fig. 1, t_2) and invariably green in colour. Unlike the underground turions, (fig. 1, t_1, t_2; and fig. 3) the distal end in this case is but mildly curved.

The turion consists of a condensed axis with 12-15 internodes studded with rather fleshy leaves arranged in alternating whorls of three at each node. These leaves are very different from the normal foliage leaves in so far as they are shorter and broader and fleshy

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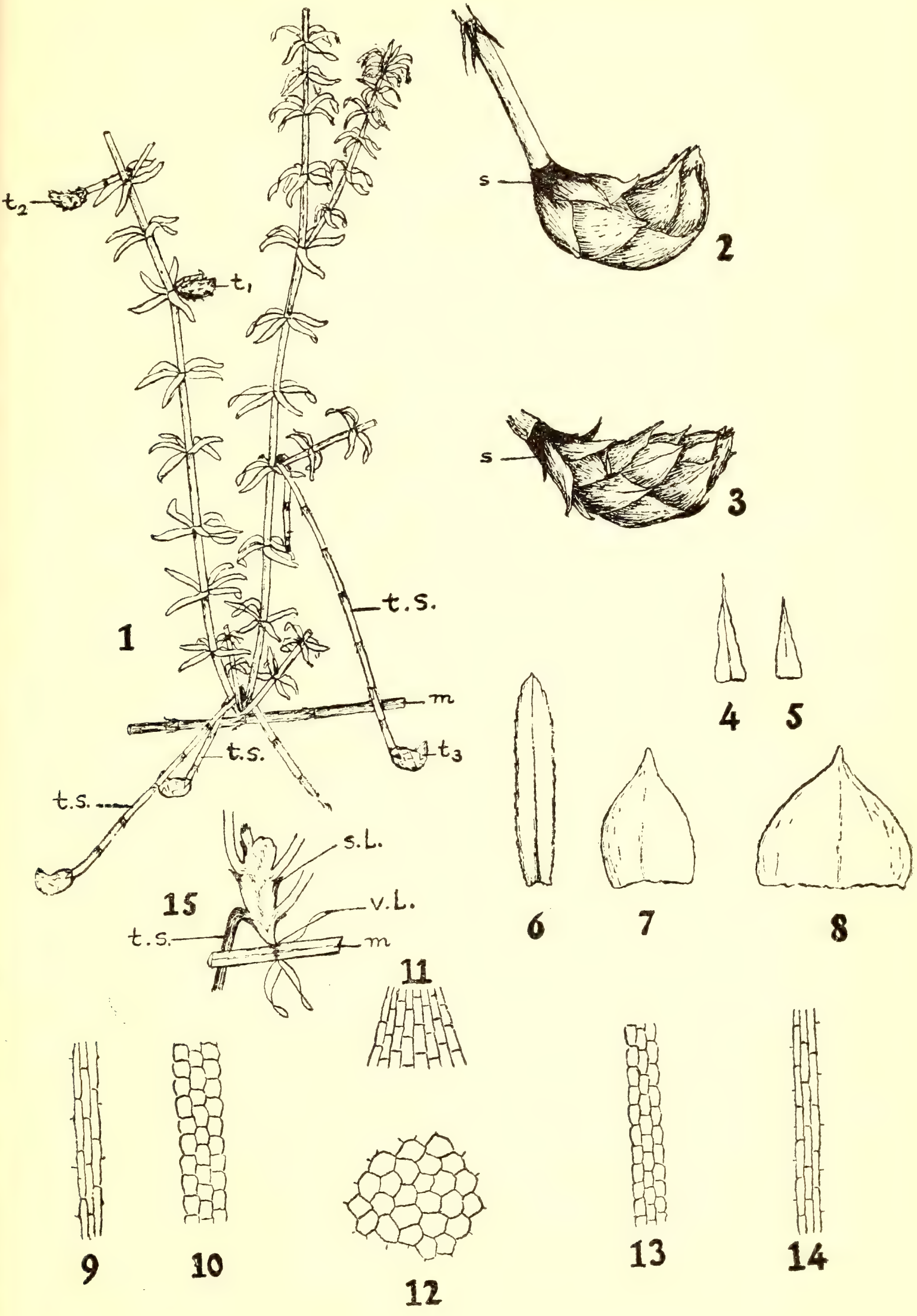
(1) Arber, A. (1920): Water Plants (Cambridge University Press), p. 219.

(2) Safeeulla, K. M. and Govindu, H. C. (1949); Occurrence of turions in *Elodea canadensis*. *Current Science*, **18** (11): 414-415.

Hydrilla verticillata Presl.


t_2
t_1
s
2
s
3
t.s.
1
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t.s.
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v.L.
t.s.
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12
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14

(figs. 7, 8). The axis is thick and stumpy ending in a conical growing apex. Both types of turions are filled with reserve food material in the form of starch.

At the nodes of the turion-ended shoots (fig. 1, *t.s.*), are borne membraneous scale leaves arranged in whorls of 4-6. These scale leaves are, however, smaller than those which form a cup at the base of the turion (figs. 2 *s*, 3 *s*, 4 and 5).

The foliage leaves of the main vegetative shoots, the scale leaves of the turion and those of the shoots bearing the turions, show certain interesting structural differences in their epidermis. The midrib region of the foliage leaf consists of narrow elongated cells (fig. 9) and its laminar region on either side has broader tabular cells (fig. 10). But the scale leaves of the shoot bearing the turion peculiarly show a reversed arrangement, namely, the midrib region has broader cells (fig. 13) than the laminar region (fig. 14). In the fleshy scale leaves of the turion, however, the narrow cells are restricted towards the tip region (fig. 11); whereas, towards the basal region the cells are parenchymatous and bigger (fig. 12).

As mentioned above, among the two types of turions the one formed inside the mud is slightly more curved (fig. 1, t_3 and fig. 2), than the one formed above the mud-level (fig. 1, t_1 and t_2, and fig. 3), excepting this difference, the general shape of both is similar. The growing apex of both of them is turned upwads (fig. 1, t_1 & t_2, and fig. 2 and 3). However, the shoots bearing the turions show certain marked differences. In such cases where the turions are formed above the mud-level and are borne on lateral shoots, the latter always arise at right angles to the main axis (fig. 1, t_1). But the shoots of the subterranean turions are positively geotropic showing strong obtuse curvature, in respect of the main axis (fig. 1, *t.s.*).

It is significant to note that the green turions are formed on plants only confined to the margins of the pools in shallow waters.

In the closely allied member *Elodea canadensis* Michx. turions have been known and described as winter-buds, because they are formed only in winter (1); but recently Safeeulla and Govindu have shown that under conditions prevailing at Bangalore, the turions may be formed even during summer. A notable difference in *Hydrilla*, however, is the simultaneous occurrence of turions both embedded inside the mud and over the mud-level submerged in water. The latter type of turions are the same size as that of the subterranean ones, except for the fact that the leaves are green in the former whereas they are cream-white in the latter.

It is my pleasant duty to express my grateful thanks to Prof. T. C. N. Singh, D.SC., F.B.S., Professor and Head of the Department of Botany, Annamalai University under whom the work has been carried out, and for his valuable guidance, criticisms and suggestions during the course of the preparation of this paper.

DEPARTMENT OF BOTANY,
ANNAMALAI UNIVERSITY.
1st *September*, 1950.

C. LAKSHMANAN, B.SC. (Mad.),
Research Scholar.

EXPLANATION OF THE PLATE

(m = vegetative branch trailing under mud; s = scale leaves forming the cup below the turion; t_1 = a sessile turion formed above the mud-level in water; t_2 = a stalked turion formed above the mud-level in water; t_3 = subterranean turion; *t. s.* = a shoot ending in turion; *v.* 1. = a normal foliage leaf in the axil of which the condensed shoot arises; *s.* 1. = a scale leaf in the axil of which a vegetative or positively geotropic branch arise.)

Fig. 1. *Hydrilla verticillata* Presl.: showing two types of turions. x 1.

Fig. 2. A subterranean turion formed under mud. x 5.

Fig. 3. Green turion formed above the mud-level on the main vegetative shoot. x 5.

Fig. 4. A scale leaf from the ultimate base of the turion. x 5.

Fig. 5. A scale leaf from a whorl of leaves on the shoot ending in a turion. x 5.

Fig. 6. A normal foliage leaf from a vegetative shoot. x 4.

Fig. 7. A leaf from a green turion. x 4.

Fig. 8. A leaf from a subterranean turion. x 4.

Fig. 9. Cells of the midrib of a normal foliage leaf. x 120.

Fig. 10. Cells of the laminar region of the normal foliage leaf. x 120.

Fig. 11. Cells of the apical part of the leaf of the turion. x 120.

Fig. 12. Cells of the basal part of the leaf of the turion. x 120.

Fig. 13. Cells of the midrib of the scale leaf of the shoot bearing turion. x 120.

Fig. 14. Cells of the laminar region of the scale leaf of the shoot bearing turion. x 120.

Fig. 15. Longitudinal section of the condensed shoot bearing normal vegetative branches and positively geotropic branch which gives rise to a subterranean turion. x 15.

25. *MUNTINGIA CALABURA* LINN., A DROUGHT RESISTANT EXOTIC PLANT

(*With a photo*)

Muntingia calabura Linn. is a medium spreading tree belonging to Elaeocarpaceae introduced in Madras Province very recently. Its native home is in Tropical America and is reported by Macmillan[1] to have been introduced in Ceylon in 1912. Apart from this information further details regarding this plant are lacking. From enquiries it is learned that a few plants are found in the gardens of Madras and Coconada, and also in the Botanic Garden of the Annamalai University. These are reported to be thriving.

Within two years of planting in the botanic gardens at the Agricultural College, Bapatlal, where the soil is sandy and poor, the plant has attained a height of twelve feet with an average spread of six feet either way. The trunk measures 15″ in circumference at the base. A perusal of the photograph will illustrate this remarkable feature.

The plant fruits within a year of planting and commences to bear regularly from the second year. It blossoms almost throughout the year and stray harvest of fruits all through the year is not an uncommon feature. The peak period ranges in summer between May and July. The fruit is green and slightly obovate in the initial stages; it attains a crimson red colour when fully ripe, and is very attractive possessing also a pleasing flavour. Because of these features squirrels and parrots are easily attracted to feast upon the fruits. The seeds are minute and the pulp is finely granular. The plant is propagated commonly by layers or root suckers. Attempts to raise by cuttings or seeds have not met with success.

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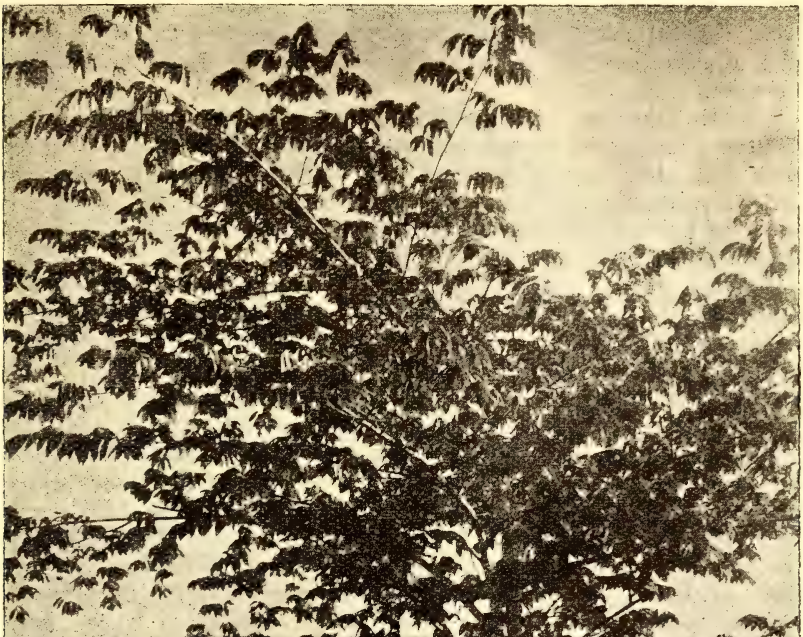
[1] Macmillan, H. F. (1946); Tropical Gardening and Planting.



The plant is drought resistant and requires very little attention for its maintenance. It has established itself well in Bapatla, where the soil is poor, sandy and the water table high. When the temperature remained over 112°F. for over a fortnight in May and June, 1948 many plants in this locality including coconuts showed severe scorching of leaf tip and margins, and some even succumbed in the heat wave which touched 118°F. Surprisingly enough this plant remained quite unaffected.

The Department of Agriculture has advocated the use of this plant for planting in all agricultural farms in this province and it is hoped that plant lovers will not lag behind in utilising this exotic plant for economic purposes as a fruit and even as a fuel yielding tree because of its extreme quick growth in the initial years and its drought resistant nature.

In view of the exotic origin, and meagre information available on this plant, a brief botanical description of it is given below:—

Muntingia calabura Linn. (Eloeocarpaceae.) A Tropical American, middle-sized spreading tree. *Stem*: Terete, tender portions glandular and pubescent. *Leaves*: Alternate, simple, oblique, pubescent, glandular and sticky, serrate, 5 to 7 cms. wide, tapering towards the end, stipulate, stipules hairy, pubescent, glandular and deciduous. *Flowers*: Profuse, axillary and solitary, regular, white and symmetrical. *Sepals*: Green, glandular, pubescent, free, valvate. *Petals*: 5 free, white, inserted around torus, valvate. *Stamens*: Indefinite, anthers 2-celled, dehiscing by lateral clefts. *Ovary*: 5-celled, free, superior, sessile on the torus, stigma terminal, 5-fid, connate. *Fruit*: Green, obovate when unripe, crimson red when ripe, of the size of a marble, connate stigma persistent, pericarp leathery, seeds copious, minute.

I am grateful to Dr. T. C. N. Singh, M.SC., D.SC., F.B.S., Professor and Head of the Department of Botany, Annamalai University, Annamalainagar for his helpful criticisms and suggestions.

L. VENKATARATNAM,
M.SC., B.SC. (Ag.)
Plant Physiologist.

AGRICULTURAL COLLEGE,
BAPATLA.

26. GLEANINGS

Tibetan Antelope.

'The Tibetan antelope has some curious characteristics, which must be remembered when hunting them. They have little or no sense of smell, but excellent sight. During July and August they are attacked by a sort of fly, which lays its eggs under the skin on the rump. These eggs mature to grubs. I have cut these grubs out of some antelope that I have shot and found them to be about 1½ in. long and as thick as a man's little finger. Naturally, these grubs set up intense irritation and annoy the animal.

The antelope stop feeding at about 10 a.m. and then lie up in shallow pits which they dig on the lower slopes of the mountains.

The sun striking down on their backs sets the grubs to work, and it is seldom that the antelope stay in the same place for more than 20 minutes on end. They will suddenly jump up from their resting places and go off, as if demented, at full speed. When they have been driven to move by the activities of these grubs or flies, they are entirely oblivious to danger.'—Lieut.-Colonel G. E. C. Gregory in 'The World's White Roof Tree' from the '*Field*', September 9, 1950, page 417.

Chick and King Cobra Venom

On pages 326 and 327 of Vol. V, No. 2 (New Series) of the *Sarawak Museum Journal,* dated September 1950, Tom Harrisson refers to a king cobra in captivity which was offered rats and frogs all of which were promptly attacked and killed, but subsequently not taken as food. In an effort to feed it a newly hatched chick was put into the cage and the king cobra struck and shook it several times during the 18 hours it was left with it. The chick was, however, later removed and grew into a handsome cock! Reference is also made to a Sakai belief that chickens are immune to snake bite.

The attention of the Haffkine Institute, Bombay, was drawn to this note. They tell us that they have experimented with very young chicks as well as older birds, but none of them survived an injection of as small a quantity as one-tenth milligramme of cobra venom. In an effective bite over 500 times this quantity is injected.

Stones in Crocodiles

In the '*Field*' dated 14th October 1950, page 634, is an interesting note entitled 'Some Crocodile Enigmas' by Major W. Robert Foran. He refers to stones found in their stomachs and quotes Colonel C. R. S. Pitman as suggesting that they may possibly help the digestive juices to remain in condition during long periods of abstinence from food. The late Sir Henry H. Ostler is quoted as stating that he had seen a 15 ft. *Crocodilus porosus* owned by a man in North Queensland throwing up eight stones, some nearly as large as a man's fist. These were reswallowed when the creature was next fed, and then vomitted again after some days.

The Duck that got away !

Harold Hanson and Robert Smith in their booklet entitled 'Canada Geese of the Mississippi Flyway' which appeared in the March 1950 issue of the *Bulletin of the Illinois Natural History Survey* refer to recent fluoroscopic studies made by the Illinois Natural History Survey of ducks trapped at Spring Lake on the Mississippi River and at Lake Chautauqua on the Illinois River which reveal that approximately 25% of the mallards migrating through these areas carry lead shot in their bodies as a result of shooting.

A Shamming Snake

Sir,

Mr. Swann's letter in the *'Field'* of April 29th recalls to my memory a strange experience at Barrackpore at the beginning of the monsoon in 1947.

From my verandah I saw on the drive about 20 yards away a large cobra writhing and squirming as if in its death throes. Beside it a common myna, seemingly also injured, was fluttering and pecking at the head of the snake.

I have heard it alleged, but have never quite believed, that snakes do sham injury in order to attract victims. My scepticism was unfortunate. But for it, I would have waited to see what happened. As it was I picked up a cane and went to dispatch the cobra, which promptly shot off into the undergrowth, while a perfectly uninjured myna flew away.

Is my scepticism unfounded? What is the true explanation of conduct of (i) the snake (ii) the bird?

BROADWATER,
SUSSEX. STEWART E. P. ATHERLEY

From the *'Field'* dated 8th July, 1950, p. 71.

THE INTERNATIONAL UNION FOR THE PROTECTION OF NATURE

By

LT.-COL. R. W. BURTON, I.A. (Retd.)

The I.U.P.N. was established at Fontainebleau on the 5th October 1948. Thirty-three countries in all were represented at the Conference.

A clear definition of the meaning of 'Nature Protection' was given:

'The term "Protection of Nature" may be defined as the preservation of the entire world biotic community, or man's natural environment, which includes the earth's renewable natural resources of which it is composed, and on which rests the foundation of human civilization.'

It was also declared that:

'———ever more effective means for exploiting these resources (are required) and moreover soils, water, wild life and wilderness areas are of vital importance for economic, social, educational and cultural reasons.'

Also that:

'Protection of Nature is a matter of vital concern to all nations, and the furthering of it is the primary concern of no single effective international agency.'

The objects of the Union were declared to be:—

1. The Union shall encourage and facilitate co-operation between governments and national and international organizations concerned with, and persons interested in, the 'Protection of Nature'.

2. The Union shall promote and recommend national and international action in respect to:—

(*a*) The preservation in all parts of the world of wild life and the natural environment, soils, water, forests, including the protection and preservation of areas, objects and fauna and flora having scientific, historic, or aesthetic significance by appropriate legislation such as the establishment of national parks, nature reserves and monuments and wild life refuges, with special regard to the preservation of species threatened with extinction;

(*b*) The spread of public knowledge about 'Protection of Nature';

(*c*) The promotion of an extensive programme of education in the field of the 'Protection of Nature';

(*d*) The preparation of international draft agreements and a world-wide convention for the 'Protection of Nature';

(*e*) Scientific research relating to the 'Protection of Nature .

3. The Union shall collect, analyze, interpret and disseminate information about the 'Protection of Nature'. It shall distribute to governments and national and international organizations, documents,

legislative texts, scientific studies and other information concerning the 'Protection of Nature'.

Under the initiative and auspices of UNESCO an international and technical conference on the Protection of Nature was assembled at Lake Success on August 22-27, 1949 and passed a series of 21 resolutions of world-wide importance.

All the above is set out for the information of those who may not be completely aware of the origin and purposes of this new-born Union whose activities are of vital moment to all peoples of the world; and to have clearly in mind the purposes of the Union for a consideration of their bearing on conditions prevailing in India.

The First Resolution

Within the seven paragraphs of the first resolution is clearly and concisely outlined why and how it is necessary to increase knowledge of human ecology, by whom this should be done, the methods necessary and, finally:

> '7. The results of these studies should be published and made available to specialists. Also popular versions of the scientific results should be made available in several languages to the general public.'

The underlined words contain the real kernel of the matter. Grandiose scientific resolutions can be of no final practical value unless the facts and results of scientific investigations and researches are visually placed before the literates of the people (which includes the various grades of all the administrative departments concerned) through suitable popular literature and demonstrated on the land and in the forests to those sections of the people who are vitally affected in their living conditions by the scientific conclusions in various fields of research.

Practical methods for giving effect to this will be for consideration by the Central and Provincial governments; perhaps the solution may lie with the radio, which has been likened to the spreading branches and tendrils of a banyan tree penetrating to all parts of the country, supplemented by cinema and propaganda vans visiting all village weekly markets and also contacting rural population throughout the land.

Lately, prominent people have said:

> 'Ultimately it is on the application of science that all progress depends.' and,
>
> 'There is lack of adequate provision to put the results of research into actual practice.'

Soil and erosion; water and increase of productive acres; overgrazing, improvement of fodder supplies and of cattle breeds; afforestation outside forest areas to remedy past neglect and present misuse; urban and rural planting of trees including provision and maintenance of tree nurseries, proper planting methods and methodical post-planting maintenance are some of the most important directions in which effort is urgently called for.

Then there is the need for village communities to provide for themselves by establishment of village coppices, and other plantings of selected varieties, much needed fuel and wood for numerous agricultural requirements—sheds, carts, ploughs, hedges, etc.

Practical fish conservation is necessary. It is not only through pond and tank culture, but through protection of the natural supply which is in all the waters of this country in great abundance, if guarded against wasteful and illegal destructive methods, that the people can obtain the much needed proteins in their diet. Also, for many years and right up to the present time, weirs and dams across rivers in many parts of India have, almost without exception, been unprovided with efficient ladders for needs of migratory species of fish. Consequently some of the great rivers and their tributaries have been largely denuded of certain species of great economical value.

There is great necessity for protection and conservation of wild life, fauna and flora according to the methodical order called 'Balance in Nature'. In this the aid of scientists is called for. Uninstructed clamour on the part of the cultivating classes entailing the destruction of edible species of animals and birds, as also the almost unrestricted trapping and snaring of ground game, antelope and gazelle is doing enormous damage all over the country to the inherited wild life resources of the Republic of India.

All these and various other matters are within the purview of this first admirable Resolution.

'Where there is no vision the people perish.'—'The first necessity, if a man is to study life, is to cease to destroy it.'—'Constitutional and legal provisions are meaningless unless they are enforced. '— 'Can there be anything more humiliating to a government than that it should make laws which are violated at the discretion of the people—and the violators not punished.'

All these utterances have direct bearing if the labours of scientists are to have desired results.

Education.—The next four **resolutions** deal with **the** fundamental importance of the widest possible distribution of educational material—films, books, leaflets, attractively designed and illustrated booklets as produced in such profusion in some western countries; the necessity that the organizations concerned with the protection of nature and conservation and utilization of resources should collaborate to the greatest possible extent; the great importance of encouraging youth movements in favour of nature protection and conservation such as already exist in a number of countries. India has none of these. It is the aim of I.U.P.N. to take steps to bring into being in all countries youth clubs devoted to the study and conservation of Nature; the promoting of international Fellowships for study and training in countries with a highly developed conservation science and technology is envisaged.

Primary and secondary schools.— The sixth resolution resolves:

'That the International Union for the Protection of Nature recommend to UNESCO that it informs governments of the vital need for the introduction of the teaching of the principles of nature protection and conservation in the curricula of primary and secondary schools, and of universities and technical colleges, either as special courses or as part of existing ones related to the subject matter.'

That is of the utmost importance, as has been urged by the present writer for 'the youth of to-day must become the conservationists of to-morrow'.

In America the adoption of a 'Conservation Pledge' has had great results. Such a pledge might well be adopted by all youth organizations and for nature study classes.

CONSERVATION PLEDGE

'I give my pledge as a citizen of the Republic of India to save and faithfully to defend from waste the natural resources of my country, its soil and minerals, its forests, waters and wild life.'

Large-scale projects.—The next resolution envisages the promotion, in connection with large-scale projects, of co-operation with one or more of the organizations executing such projects, detailed ecological surveys which would furnish at the same time the most vital data in regard to those developments on the overall living environment in the areas affected, and valuable information to guide the development of similar projects.

This is of course, as are all the others also, a very important matter. Agriculture, malaria, fish supplies, afforestation and other aspects of human ecology are all concerned. Co-operation, exchange of ideas and experiences are most valuable in connection with all large-scale undertakings such as are in view in India at the present time.

Insecticides.—Resolutions 8, 9 and 10 deal with the use and misuse of insecticides; the effective regulation of their use, as also of fungicides, herbicides, rodenticides for the protection of human interests, the object being to protect the equilibrium of nature by preventing the destruction of animal and plant communities. It is declared that proposals should be worked out, and transmitted to a co-ordinating body such as a 'permanent Joint Commission on Insecticides' to be formed by FAO, WHO and UNESCO.

Resolution No. 11 deals with treatment of cattle in Africa against trypanosomiasis and does not concern India. So also, No. 14, 19, and 20, do not apply to this country.

Exotic Species.—Resolution No. 12 recommends to governments submission of their plans for importation of exotic species of animals and plants for approval of one of the scientific services dealing with nature protection and conservation, and has special reference to creation of parks for exotic animals, industrial breeding projects (fur animals, etc.), and fish farming.

This has interest for India, and will attract attention of government departments concerned.

Scientific Committees.—The I.U.P.N. resolves in No. 13 that certain countries or groups of countries promote the establishment of scientific committees composed of a small number of naturalists or ecologists to supply the Union with information in the field of ecology, and the true situation in regard to the protection of nature. This is of moment to all countries as providing the essential contacts for fulfilment of the objects of the Union.

In India, at the present time, while all aspects of the protection of Nature are of great importance, perhaps it is erosion, afforestation and cattle fodder, conservation of fish in waters of all rivers and streams, and wild life conservation which can claim priority.

Vanishing Assets.—Considering that the world is faced with an increasing list of threatened and vanishing species of fauna and flora, the Conference resolves (No. 15) that the I.U.P.N. should establish a 'survival service' for the assembling, evaluation and dissemination of information on, and the study of, all such cases in order to assist governments and appropriate agencies in securing their survival.

The next Resolution gives a partial list of threatened birds and animals, which include the Indian pink-headed duck and the Indian rhinoceros, the Asiatic lion, and the Burmese brow-antlered deer of which one race is found in Manipur; and further provides measures for maintenance of an open list of such rare and threatened species and promotion of such ecological research, and such measures as would be necessary and effective for their preservation.

Resolution 18 deals specifically with the Great Indian One-horned Rhinoceros and urges the Government of India to recommend to the Provincial Government of Assam to take such steps in collaboration with the I.U.P.N. as will protect and preserve the species, especially in the Kaziranga Sanctuary which should be set aside as an inviolable Rhinoceros Sanctuary.

Resolution 17 recommends immediate and vigorous action by Governments in respect to rare and threatened plant species and maintenance of an open list in respect to them.

Food. Resolution No. 21, referring to the Beirut (1948) Session of UNESCO, states that conservation of food resources is one of the primary responsibilities of FAO, and points out that the I.U.P.N. brings together specialists of various countries who are concerned with the fundamental scientific problems of conservation. It further makes clear that the function of UNESCO in a world-wide programme of food resources should be determined between UNESCO and FAO, and that the educational and basic scientific aspects of such a programme should be given special consideration by UNESCO.

It also suggests that it would be to their interest to consult I.U.P.N., and that the latter should receive from FAO and UNESCO all necessary documentation and information pertaining to their work in the field of conservation.

SUMMARY

Scientists in all the many fields of modern research having perused and studied the above, will perhaps be more than ever brought to realize the importance of their labours in the cause of humanity, and the better use that can be made through their conclusions of the 'preservation of the earth's renewable natural resources of which it is composed and on which rests the foundation of human civilization'.

CONCLUSION

In respect to all the many matters dealt with, satisfactory results cannot be achieved by government efforts alone. The people also have their responsibilities, and unless these are whole-heartedly and willingly discharged any amount of effort on the part of the government cannot have adequate results.

Therefore it is that the future well-being of the peoples of the Republic of India rests with the scientists, the government, and the people themselves—the people in every class of life and in every occupation and pursuit, and in all this they have the wise counsels and invaluable support of the International Union for the Protection of Nature.

[As announced in the Appendix to the Honorary Secretary's Report for 1949 (*Journal* 49 (3): 586), the Society has joined the International Union for the Protection of Nature in order the better to further its efforts in the cause of India. The above article was originally written by Col. Burton for *Science & Culture* and is here reproduced with acknowledgements to its editor and publishers.

Since the publication of the article it has been announced in the press (Delhi, 1st November 1950) that the Indian Agricultural Research Council, under its new constitution, has established 3 new bodies, one of which is named 'Extension Board'.

The Extension Board is charged with carrying the results of research to the farmer. The Board includes the Directors of Agriculture and heads of Fishery Services, Animal Husbandry and Forest Departments from the various State Governments.

It is gratifying to note that the Extension Board, as above constituted, fully satisfies Col. Burton's remarks under *The First Resolution* (p. 806)—EDS.]

BOMBAY WILD ANIMALS AND WILD BIRDS PROTECTION ACT 1951

By

The Editors

All of us who have shot in India must have had occasion to regret the impunity with which poaching is carried on in various places and the impotency of the few game laws which hitherto existed.

A few years ago, the Bombay Natural History Society attempted to prevent partridge being advertised for sale on the Bombay market and on hotel menus during the close season, but the police expressed their inability to prosecute with any hope of conviction under the existing laws.

Representation was then made to the Director of Parks and Gardens who offered to move the Government of Bombay for changes in the laws if some definite proposals were made to him. A draft bill prepared by Mr. Humayun Abdulali on behalf of the Society was presented at a meeting of the Parks and Gardens Advisory Committee who referred it to a sub-committee for further examination. Mr. J. A. Singh, till recently the Conservator of Forests, Bombay, was also on this Committee and with his assistance we went over the draft many times revising and recasting it in the light of suggestions collected from many co-operators and well-wishers. Prominent among these were Lt.-Col. R. W. Burton, Lt.-Col. E. G. Phythian-Adams, Mr. R. C. Morris, Mrs. Jamal Ara, Mr. P. D. Stracey, Mr. M. J. Hackney, the late Mr. H. B. Hayes, Mr. W. F. H. Ansell and Col. C. L. Boyle, the Hon. Secretary of the Fauna Preservation Society. Col. Boyle kindly circulated the draft among a number of other people with practical experience of Indian conditions, and some very valuable suggestions were elicited. We were also sent copies of allied legislation in force in various parts of Africa which helped greatly in drafting the Act. The following were consulted and drawn upon:—

INDIA

1. The Rules and Bye-laws of the Toorsa-Sankos Fishing and Shooting Association (Dooars, Bengal).
2. Bengal Act V of 1932—The Elephants Preservation (Bengal Amendment) Act 1932.
3. Bengal Act II of 1938—The Bengal Rhinoceros Preservation (Amendment) Act, 1937.
4. Bengal Act VIII of 1932—The Bengal Rhinoceros Preservation Act, 1932.
5. The Memorandum of the Constitution of the Game Federation of Bengal.
6. Correction Slip No. 36 to the Bengal Presidency Manual, Part I.
7. Correction Slip No. 87 to the Bengal Presidency Forest Manual, Part I.
8. Government of Bihar Revenue Department, Notification of 30th March 1948.

9. Bihar and Orissa Government Reserved Forests Shooting Rules 1932.

10. The Central Provinces and Berar Game Rules, 1942 and the Shooting Rules.

11. Government of India Act No. VIII of 1912—Act to make better provision for the protection and preservation of certain wild birds and animals.

12. The Indian Forest Act of 1927.

13. The Bihar Wild Birds and Animals Protection Act.

14. Madras Game Laws and Shooting and Fishing Rules also Licence.

15. The Punjab Wild Birds and Animals Protection Act.

16. Sind Wild Birds and Wild Animals Protection Act, 1940.

17. Shooting Rules in force in the United Provinces.

18. Wild Birds and Animals Protection Act (VIII of 1912)—Close time for wild birds and animals in the U.P.

CEYLON

19. The Legislative Enactments of Ceylon—Fauna and Flora Protection Ordinance (1938 Revision).

20. Parliament of Ceylon 3rd Session 1949—Fauna and Flora Protection (Amendment) Act, No. 38 of 1949.

GREAT BRITAIN

21. Game Laws at a Glance (published by the British Field Sports Society).

AFRICA

22. Colony and Protectorate of Kenya—An Ordinance to consolidate and amend the law relating to the Protection of Game Animals and Game Birds.

23. Colony and Protectorate of Kenya—An Ordinance to amend the Game Ordinance 1937.

24. Colony and Protectorate of Kenya—An Ordinance to consolidate and amend the law relating to the Protection of Game Animals and Game Birds.

25. Northern Rhodesia—Notes on the Game Ordinance with Schedules and Fees (July 1949).

26. Northern Rhodesia—Game: Chapter 106 of the laws (1949 Edition).

Though a considerable amount of time and energy was expended in this effort, the whole process was interesting and has revealed many significant and often curious facts. One of them appears to be a flaw in the Constitution Act which prevents the provinces from legislating in connection with any living creatures other than men, animals (which means only mammals) birds and fish! In view of this difficulty it has been found necessary to delete reference to the protection to crocodiles, lizards, frogs and all invertebrates. None of them appear to need any immediate protection in our State, but a provision in the Act might have been useful in future if occasion arose. The final draft was submitted to the Government of Bombay and we understand that it has been approved by both the Houses of Legislature. The crux of the whole Act is the appointment of a Special Wild Life Preservation Officer for which the Society has long agitated, and that section which makes it incumbent upon the accused, if found in possession of a game animal and suspected of committing a breach of the game laws, to prove that his trophy was legally acquired. Another important feature is the appointment of honorary game wardens who, if properly selected and armed with police powers should, we feel, act as effective deterrents to poaching. It is self evident that the co-operation of the shooting fraternity is the first essential towards the success of this new Department. We hope that members of the Society will give government all possible support, and also attempt to get similar legislation passed in all the other States of the Union.

The Government of Bombay as a preamble to the bill give a statement of objects and reasons as follows:

STATEMENT OF OBJECTS AND REASONS

"Wild-life is a valuable natural resource and its conservation, therefore, is considered as a national wealth. In its fauna, nature has endowed India with a magnificent asset. The forests in the State of Bombay are well known for wild birds and animals of various species. It is the duty of the State to protect the useful and beautiful wild things of the woodlands. The forest wild-life has many values. It provides in the way of hunting. It yields hides, pelts, skins, tusk and teeth, etc., that bring cash to the State. Wild creatures provide a service that we often fail to appreciate because it is not obvious—they contribute to the natural balance that helps to keep forests in condition. Without regulation, this valuable resource is in danger of extinction and it is, therefore, essential that suitable steps should be taken for its conservation. The present Bill aims at conserving wild-life in the State of Bombay and also at keeping in check wild birds and animals which are a danger to human life and agricultural crops.

The Government of India recognised, as long ago as 1912, the prime necessity of conserving wild-life and they passed the Wild Birds and Animals Protection Act, 1912. The present Bill contemplates repeal of the Government of India Act in its application to the State of Bombay, as the provisions of that Act are not sufficiently wide to cover the requirements. The provisions of the present Bill cover the various questions pertaining to the preservation of wild-life and provision has been made in the Bill for the establishment of Game Sanctuaries for the purpose.

The presence of sportsmen of the right kind has been found to be the best guarantee for preservation of wild-life. The Bill, therefore, provides for the grant of shooting licences with certain reservations in the best interests of wild-life.

Recently, so many States have merged in the State of Bombay. This has increased the State forest area considerably. In view of this, it is proposed to appoint an independent officer with necessary staff for seeing that the provisions of the Bill are properly implemented. Forest Officers are fully engaged with their normal work and cannot find time for effectively undertaking this duty.

With a view to obtaining expert advice of persons and associations connected with wild-life preservation, provision has been made in the Bill for appointment of an Advisory Board consisting of officials and non-officials. This will help Government in gauging the general trend of opinion as regards selection of areas for game sanctuaries and formulation of policy regarding grant of licences and other matters connected with the preservation of wild-life.''

TEXT OF A BILL TO MAKE ADEQUATE PROVISION FOR THE PROTECTION OF WILD ANIMALS AND BIRDS IN THE STATE OF BOMBAY

WHEREAS it is expedient to make better and adequate provision for the preservation and protection of wild animals and wild birds in the State of Bombay and for certain other matters hereinafter appearing; it is hereby enacted as follows:—

CHAPTER I

PRELIMINARY

Short title, extent and commencement.

1. (*1*) This Act may be called the Bombay Wild Animals and Wild Birds Protection Act, 1950.

(*2*) It extends to the whole of the State of Bombay.

(*3*) It shall come into force on such date as the State Government may, by notification in the *Official Gazette,* appoint.

Definitions.

2. In this Act, unless there is anything repugnant in the subject or context,—

(*a*) 'Animal or Bird' includes the young ones of the animal or bird, as the case may be;

(*b*) 'Big Game' means any animal specified in Schedule III or IV;

(*c*) 'Game' means any animal or bird specified in Schedule II, III, or IV;

(*d*) 'Game Officer' means any officer, warden or servant appointed or authorized for any of the purposes of this Act;

(*e*) 'Hunt' means to hunt, kill or capture any animal or bird by any method and includes every attempt to kill or capture it or to take or destroy any part of its body or eggs or nest or to disturb its eggs or nest.

(*f*) 'Licence' means a licence granted under this Act;

(*g*) 'Meat' includes fat, blood, flesh and bones;

(*h*) 'Permit' means a permit granted under this Act;

(*i*) 'Prescribed' means prescribed by rules;

(*j*) 'Rules' means rules made under section 48;

(*k*) 'Schedule' means a Schedule appended to this Act;

(*l*) 'Small Game' means any animal or bird specified in Schedule II;

(*m*) 'Trophy' means the durable part of an animal or a bird which has been preserved by any means, whether natural or artificial, and includes the head or horn, tooth, tusk, bone, claw, hoof, skin, hair, feather, eggs or nest of any bird, but does not include any article manufactured from any such part of the animal or bird as aforesaid;

(*n*) 'Vermin' means any animal or bird specified in Schedule I and includes any animal or bird declared to be a vermin under section 18.

3. Nothing in this Act shall apply to domesticated or other animals or birds which are lawfully captured and kept in captivity.

Domesticated and other animals and birds in captivity exempted.

CHAPTER II

AUTHORITIES TO BE APPOINTED OR CONSTITUTED UNDER THE ACT

Appointment of Wild Life Preservation Officer, Game Wardens and other Games Officers.

4. (*1*) The State Government may for the purposes of this Act appoint,

(*a*) the Wild Life Preservation Officer for the State of Bombay;

(*b*) the Game Wardens, either honorary or stipendiary;

(*c*) such other officers and servants as may be necesssary.

(*2*) The honorary Game Warden shall ordinarily hold office for a period of three years:

Provided that the State Government may terminate his tenure of office at any time without assigning any reason.

(*3*) The Game Wardens and other officers and servants appointed under this section shall be subordinate to the Wild Life Preservation Officer.

Delegation of powers by Wild Life Preservation Officer.

5. The Wild Life Preservation Officer may, with the approval of the State Government, by order in writing delegate any of his powers and duties under any of the provisions of this Act to any officer subordinate to him, subject to such conditions, if any, as may be specified in the order.

Constitution of State Wild Life Advisory Board.

6. (*1*) As soon as possible after the coming into force of this Act, the State Government shall constitute an advisory board hereinafter called 'the State Wild Life Advisory Board' consisting of the following ex-officio and other members nominated by the State Government, namely:—

(*a*) The Chief Secretary to the Government of Bombay as the Chairman;

(*b*) One representative of the Bombay Legislative Assembly;

(*c*) One representative of the Bombay Legislative Council;

(*d*) Two non-officials who in the opinion of the State Government are interested in the protection of wild animals and birds;

(*e*) One representative of the Bombay Natural History Society;

(*f*) Four other officials of Government.

(*2*) The Wild Life Preservation Officer shall be the Secretary of the Board.

(*3*) The members shall ordinarily hold office on such terms as to tenure and vacation of office as the State Government may determine:—

Provided that the tenure of office of any member may be terminated by the State Government at any time without assigning any reasons.

(*4*) The members shall be entitled to receive such allowances in respect of expenses properly incurred in the performance of their duties as the State Government may determine:—

Provided that the receipt of such allowances by the representative of the Bombay Legislative Assembly or the Bombay Legislative Council shall not be deemed to make such representative as the holder of an office of profit under the State Government.

Duties of State Wild Life Advisory Board.

7. It shall be the duty of the State Wild Life Advisory Board to advise the State Government—

(*1*) in the selection of areas to be declared as Game Sanctuaries;

(*2*) in formulating the policy in granting licences and permits under this Act and administration of Game Sanctuaries;

(*3*) in the matter of framing rules under section 48 and

(*4*) on any other matter connected with the preservation and protection of animals and birds which may be referred to it by the State Government.

Procedure of State Wild Life Advisory Board.

8. (*1*) The State Wild Life Advisory Board shall meet at least once a year at Bombay or such other place as the State Government may direct.

(*2*) The procedure (including the quorum) of the Board shall be such as the Board may, by bye-laws made in this behalf, determine.

CHAPTER III

HUNTING OF ANIMALS AND BIRDS

A. Licences

Hunting of wild animals and birds without licence prohibited.

9. No person shall hunt any wild animal or wild bird except under a licence granted under the provisions of this Act and in accordance with the conditions specified in such licence:

Provided that no such licence shall be necessary to hunt any vermin.

Registration of certain persons in possession of arms.

10. Any person who holds a licence granted under the Indian Arms Act, 1878, for the possession of arms for sport or protection or who is exempt from the provisions of that Act and possesses any arms, shall register his name and address with the Wild Life Preservation Officer or any other Officer authorized by the State Government in this behalf. Such registration shall be made on application made in the prescribed form and on payment of such fee as may be prescribed.

Procedure for licence.

11. (*1*) Any person desiring to obtain a game licence shall apply to the Wild Life Preservation Officer or any other Officer authorized by the State Government in this behalf in the prescribed form. Such application shall be accompanied by such fee for the licence as may be prescribed.

(*2*) The application may be made for any or all of the following kinds of game licences, namely:

(*a*) Small Game Licence,
(*b*) Big Game Licence,
(*c*) Special Big Game Licence,
(*d*) Pet Animals (Possession) Licence,
(*e*) Pet and other Animals (Trapping) Licence.

(*3*) On receipt of an application and after making such inquiry as he may deem necessary the Wild Life Preservation Officer or the authorized Officer may, subject to any general or special orders of the State Government, grant or refuse to grant the game licence without assigning any reasons. When a game licence is refused the fee paid therefor shall be refunded to the applicant.

(*4*) Every game licence granted under this section shall ordinarily be valid for such period as may be prescribed.

(*5*) Any person aggrieved by the refusal of a licence may within fifteen days appeal to the State Government, whose decision shall be final.

Record of game hunted to be kept and submitted.

12. (*1*) The holder of every game licence, of the kind specified in clause (*b*), (*c*) or (*e*) of sub-section (*2*) of section 11, shall keep a record containing such particulars as may be prescribed of all game killed or captured by him during the currency of his licence.

(*2*) When any game is killed or captured by the holder of such licence, he shall not later than fifteen days of the killing or capture of the game or before leaving the State of Bombay, whichever is earlier, intimate in writing to the Wild Life Preservation Officer or to any other Officer authorised by the State Government in this behalf, the prescribed particulars of the animal or bird killed or captured by him.

(*3*) Not later than fifteen days after the expiry of his licence, the holder shall surrender his licence to the Wild Life Preservation Officer or the authorized Officer and shall sign a declaration in the prescribed form certifying the accuracy of the record of the game killed or captured by him.

Issue of licences for special purposes.

13. Notwithstanding anything contained in this Act, it shall be lawful for the Wild Life Preservation Officer, upon such conditions as he may deem fit to impose, to grant a licence to any person with or without payment of fee, which shall entitle the holder to hunt animals and birds specified thereon for any of the following purposes, namely:—

(*a*) Scientific research;

(*b*) Collection of specimens for zoological gardens, museums and similar institutions; and

(*c*) Killing of such animals and birds as are a source of serious menace to human life or property.

Suspension or cancellation of licence.

14. (*1*) The Wild Life Preservation Officer or any other Officer authorized by the State Government in this behalf may, subject to any general or special orders of the State Government, without giving any previous notice and without assigning any reasons, suspend or cancel any licence granted under this Chapter.

(*2*) Any person aggrieved by the suspension or cancellation of a licence under sub-section (*1*) may within fifteen days appeal to the State Government, whose decision shall be final.

B. General

Hunting of young and female with young prohibited.

15. (*1*) Except when authorized under a specified condition to that effect in a licence, no person shall hunt the young of any game or any female game accompanied by its young or any deer with horns in velvet.

(*2*) Nothing contained in sub-section (*1*) shall apply to the hunting of vermin.

lose time.

16. The State Government may, by notification in the official *Gazette,* declare the whole year or any part thereof to be a close time throughout the whole or any part of the State of Bombay for any kind of wild animal or bird or for female or immature wild animal or bird of such kind.

Unlawful methods of hunting.

17. (*1*) No person shall hunt any game from or by means of a wheeled or a mechanically propelled vehicle on water or land or by air-craft.

(*2*) No person shall use a motor car, motor launch or air-craft, for the purpose of killing, driving or stampeding game.

(*3*) No person shall hunt any game with nets, snares, pit-falls, poison or poison-weapons, except in defence of human life or property, and except in so far as it relates to capture of animals and birds under a licence of the kind specified in clause (*e*) of sub-section (*2*) of section 11.

(*4*) No person shall for the purpose of hunting set fire to any vegetation.

(*5*) No person shall use any artificial light for the purpose of hunting, except in the case of carnivora, over a natural kill.

(*6*) No person shall hunt any game during the hours of night, *i.e.*, one hour after sun-set and one hour before sun-rise, except in the case of carnivora, by sitting over a natural kill.

(*7*) No person shall hunt any game on a salt-lick or water hole or other drinking places or on paths and approaches to the same except sand-grouse and water birds.

(*8*) No person shall hunt any game on any land of private ownership, without the consent of the owner or his agent or the lawful occupier of such land.

(*9*) No person shall, notwithstanding that he holds a game licence for the purpose, hunt any game animal during the close time.

Declaration of certain animals and birds as vermin.

18. The State Government may by notification in the official *Gazette* declare any wild animal or wild bird other than those specified in Schedule I, to be a vermin in any specified area, and it shall not be necessary to hold a licence to hunt any such animal or bird in such area.

CHAPTER IV

GAME SANCTUARIES

Power to declare any area to be Game Sanctuary.

19. The State Government may by notification in the official *Gazette* declare any area to be a Game Sanctuary, in the manner hereafter appearing.

Notification regarding declaration of Game Sanctuary.

20. Whenever it has been decided to declare any area to be Game Sanctuary, the State Government shall issue a notification in the official *Gazette,*—

(*1*) stating that it has been decided to declare such area to be a Game Sanctuary;

(*2*) specifying as nearly as possible the situation and limits of such area, and

(*3*) directing the Collector to inquire into and determine the existence, nature and extent of any rights alleged to exist in favour of any person in or over the land comprised within the limits of such area and deal with the same as provided in this Act.

Explanation.—For the purpose of this section, it shall be sufficient to describe the area by roads, rivers, ridges or other well-known or readily intelligible boundaries.

Bar of accrual of any rights in land comprised in Game Sanctuary.

21. After the issue of a notification under section 20, no right shall be acquired in or over the land comprised in such notification, except by succession.

Proclamation by Collector.

22. When a notification has been issued under section 20, the Collector shall publish in the regional language in every town and village in the neighbourhood of the area comprised therein, a proclamation—

(*a*) specifying, as nearly as possible, the situation and the limits of the proposed Game Sanctuary;

(*b*) fixing a period of not less than two months from the date of such proclamation, and requiring any person claiming any right mentioned in section 20 or section 21 within such period either to present to the Collector a written notice specifying or to appear before him and state, the nature of such right and the amount and particulars of the compensation (if any) claimed in respect thereof.

Inquiry by Collector.

23. The Collector shall take down in writing all statements made under section 22 and shall at some convenient place inquire into all claims duly preferred under that section and the existence of any rights mentioned in section 20 or 21 and not claimed under section 22 so far as the same may be ascertainable from the records of Government and the evidence of any persons likely to be acquainted with the same.

Extinction of rights.

24. Rights in respect of which no claim has been preferred under section 22 and of the existence of which no knowledge has been acquired by inquiry under section 23, shall be extinguished.

Power to acquire land over which right is claimed.

25. In the case of a claim to a right in or over any land, other than a right of public way or right of common pasture, the Collector shall either—

(*a*) exclude such land from the limits of the proposed Game Sanctuary, or

(*b*) come to an agreement with the owner thereof for the surrender of his rights, or

Act I *of* 1894.

(*c*) proceed to acquire such land in the manner provided by the Land Acquisition Act, 1894.

Acquisition Proceedings.

26. For the purpose of acquiring such land,—

I of 1894.

(*1*) the Collector shall be deemed to be a Collector proceeding under the Land Acquisition Act, 1894;

(*2*) the claimant shall be deemed to be a person interested and appearing before him in pursuance of a notice given under section 9 of that Act;

(*3*) the provisions of the preceding sections of that Act shall be deemed to have been complied with;

(*4*) the Collector with the consent of the claimant, or the Court, with the consent of both the parties, may award compensation in land or partly in land and partly in money; and

(*5*) in the case of the stoppage of a public way or a common pasture, the Collector may, with the previous sanction of the State Government, provide for a substitute public way or common pasture, as far as may be practicable or convenient.

Power of Collector to be exercised by other officers.

27. The State Government may, by general or special order, direct that the powers exercisable or the functions to be performed by the Collector under sections 20 to 26 (both inclusive) may be exercised and performed by such officer as may be specified in the order.

Restriction on entry in Game Sanctuary.

28. No person, other than,—

(*a*) any public servant on duty;

(*b*) any person who ordinarily resides within the limits of a Sanctuary;

(*c*) any person who has rights over immoveable property within the limits of a Sanctuary;

(*d*) any person passing through a Sanctuary along a public highway;

(*e*) the dependents and servants of the above persons; shall enter or reside in a Game Sanctuary, except under a permit and in accordance with the conditions of the permit granted under section 29.

Permit to enter or reside in a Game Sanctuary.

29. (*1*) The Wild Life Preservation Officer may issue to any person on application a permit to enter or reside in a Game Sanctuary for any of the following purposes, namely:—

(*a*) Investigation or study of wild life and purposes incidental thereto;

(*b*) Photography;

(*c*) Scientific research;

(*d*) To transact lawful business with any person residing in the Sanctuary.

(*2*) A permit to enter or reside in the Sanctuary shall be issued, subject to such conditions as the Wild Life Preservation Officer may deem fit to impose or as may be prescribed and such conditions shall be endorsed on the permit.

Hunting in Game Sanctuary without permit prohibited.

30. (*1*) No person shall hunt any animal or bird in a Game Sanctuary, provided that the Wild Life Preservation Officer may in any special case where he is satisfied that it is necessary that animals or birds should be hunted for the better preservation of other animal life, or for other good and sufficient reason, issue a permit authorising any person, to hunt such animals or birds under the direction of an officer authorised by him.

(*2*) A permit issued under sub-section (*1*) shall specify the number and kind of animal or bird that may be hunted by the holder of such permit.

31. (*1*) The Wild Life Preservation Officer may, for good and sufficient reason, refuse to issue any permit or may cancel any permit granted under this Chapter.

Refusal or cancellation of permit.

(*2*) Any person aggrieved by the refusal or cancellation of a permit under sub-section (*1*) may within fifteen days appeal to the State Government, whose decision shall be final.

32. No person shall set fire to a Game Sanctuary or kindle or leave any fire burning in such manner as to endanger such sanctuary.

Causing fire prohibited.

CHAPTER V

TROPHIES AND PET ANIMALS AND BIRDS

33. No person shall carry on the business of a trophy dealer or dealer in pets, except under and in accordance with the trophy dealer's licence or pets dealer's licence granted under the provisions of this Chapter.

Dealings in trophies and pets without licence prohibited.

34. A trophy dealer's or pet and other animal dealer's licence may be issued by the Wild Life Preservation Officer or by any other Officer authorized by the State Government in this behalf on application and payment of such fees as may be prescribed, and shall entitle the holder to carry on the business of a trophy dealer or dealer in pets upon the premises and conditions specified in the licence. Every such licence shall be valid for one year from the date of issue, unless duly suspended or cancelled before that period.

Trophy and pets dealer's licences.

35. A trophy dealer or dealer in pets shall keep such records and submit such returns of his dealings to the Wild Life Preservation Officer as may be prescribed.

Records and returns to be made by trophy and pets dealers.

36. The Wild Life Preservation Officer may for the purposes of section 37 issue a certificate of ownership to any person who in his opinion is in lawful possession of a trophy.

Certificate of ownership.

37. No person shall export or transfer by gift, sale or otherwise, to any person any trophy unless he is in possession of a certificate of ownership therefor and such certificate shall be delivered or sent by post to the transferee at the time of export or transfer.

Export and sale of trophies regulated.

Explanation. For the purposes of this section, 'export' means to take out of the State of Bombay otherwise than across a customs frontier.

38. Any game found dead or killed without a licence in defence of life or property or by mistake or any game or trophy in respect of which a breach of the provisions of this Act has been committed, shall be a Government trophy and the property of the State Government.

Government trophies.

39. Any person who by any means obtains possession of a Government trophy shall within 48 hours make a report thereof to the nearest Game, Police or Forest Officer and shall, if so required, hand over the trophy to him.

Possession of Government trophy to be reported.

Unlawful possession and dealings in Government trophies.

40. (*1*) No person shall without the permission of any of the Officers referred to in section 39 keep in his possession any Government trophy or without the permission of the Wild Life Preservation Officer or any other Officer authorized by the State Government in this behalf transfer, by gift, sale or otherwise, any Government trophy to any person.

(*2*) In any prosecution for contravention of the provisions of sub-section (1), it shall, until the contrary is proved and the burden of proving which shall lie on the accused, be presumed that the person in whose possession the Government trophy was found was in unlawful possession thereof.

Production of ivory or horn before Wild Life Preservation Officer.

41. Every person who kills an elephant or a bison shall produce its ivory or horn before the Wild Life Preservation Officer or any other Officer authorized by the State Government in this behalf within one month of the killing thereof, or within such further time as may be allowed by him in any special case, together with the game licence under which it was killed.

Registration of ivory or horn and identification marks.

42. The officer to whom the ivory or horn is produced under the provisions of section 41, if satisfied, after such enquiry as he may consider necessary, that the ivory or horn has been lawfully obtained, shall cause it to be weighed, marked and registered in the prescribed manner and shall return it to the person producing it together with a certificate of ownership in the prescribed form.

No ivory or horn to be transferred without a certificate of ownership.

43. No person shall in any manner transfer any such ivory or horn without the certificate of ownership obtained from the Wild Life Preservation Officer or the authorized Officer, as the case may be.

Chapter VI

Prevention and Detection of Offences and Penalties

Powers of entry, search, arrest and detention.

44. (*1*) The Wild Life Preservation Officer or any other Game Officer empowered by him or any Forest or Police Officer may, if he has reasonable grounds for believing that any person has committed an offence against this Act,—

(*a*) require any such person to produce for his inspection any animal, bird, meat or trophy in his possession or any licence, permit or other document issued to him or required to be kept by him under the provisions of this Act;

(*b*) enter and search any premises, land, vehicle or boat, in the occupation of such person and open and search any baggage or other things in his possession;

(*c*) seize any animal, bird, meat or trophy in the possession of any person and appearing to him to be the property of the State Government, and unless he is satisfied that such person will appear and answer any charge which may be preferred against him, without warrant arrest and detain him.

(*2*) It shall be lawful for any of the Officers referred to in sub-section (1) to stop and detain any person whom he sees doing any act for which a licence or permit is required under the provisions of this Act for the purposes of requiring such person to produce his licence or permit and if such person fails to produce his licence or permit, as the case may be, he may be arrested without a warrant, unless he furnishes his name and address and otherwise satisfies the officer arresting him that he will duly answer any summons or other proceedings which may be taken against him.

(*3*) Any person detained, or things seized under the foregoing powers, shall forthwith be taken before a Magistrate to be dealt with according to law.

(*4*) Any person who, without reasonable cause, fails to produce anything which under the powers conferred by this section he is required to produce, shall be guilty of an offence against this Act.

Penalties.

45. (*1*) Any person who contravenes any of the provisions of this Act or of any rules made thereunder or who commits a breach of any of the conditions of any licence or permit shall be guilty of an offence against this Act, and shall, on conviction, be punished with imprisonment which may extend to six months or with fine which may extend to Rs. 500 or with both.

(*2*) When any person is convicted of an offence against this Act, the Court trying the offence may order that any animal, bird, meat or trophy in respect of which the offence has been committed and any weapon or trap with which the offence has been committed shall be at the disposal of the State Government, and that any licence or permit held by such person under the provisions of this Act, be cancelled.

(*3*) Such cancellation of licence or permit shall be in addition to any other punishment awarded for such offence.

When Court to take cognizance of offence.

46. No Court shall take cognizance of any offence against this Act:

(*1*) except on the complaint or report of the Wild Life Preservation Officer or any Officer authorized by him or of any Forest or Police Officer or of any other Officer authorized by the State Government in this behalf; and

(*2*) unless the prosecution is instituted within three months from the date on which the offence is alleged to have been committed.

Operation of other laws not barred.

47. Nothing in this Act shall be deemed to prevent any person from being prosecuted under any other law for any act or omission which constitutes an offence under this Act or from being liable under such other law to any higher punishment or penalty than that provided by this Act:

Provided that no person shall be punished twice for the same offence.

CHAPTER VII

MISCELLANEOUS

Power to make rules.

48. (*1*) The State Government may make rules for carrying out the purposes of this Act.

(*2*) In particular and without prejudice to the generality of the foregoing power, such rules may be made for all or any of the following matters, namely—

(*a*) the forms to be used for any application, licence, permit, registration, declaration, certificate, return or other documents, granted, issued, made or submitted under the provisions of this Act and the fees, if any, therefor;

(*b*) the conditions subject to which any licence or permit may be granted under this Act;

(*c*) the particulars of the record of game killed or captured to be kept and submitted by any licensee;

(*d*) controlling settlements in game sanctuaries with a view to preventing disturbance to the natural fauna;

(*e*) regulating the sale of pet and other animals and trophy derived from the wild animals and birds;

(*f*) manner of registration of ivory or horn of elephant or bison brought for such registration;

(*g*) any other matter for which in the opinion of the State Government provision is expedient or necessary to carry out the object of this Act.

(*3*) The power to make rules under this section shall be exercised subject to the condition of previous publication.

(*4*) The rules made under this section shall be published in the official *Gazette* and on such publication shall have effect as if enacted in this Act.

Power to amend Schedules.

49. For the purpose of preserving or protecting the rare species of wild animals and wild birds, protecting such animals and birds during the breeding season and for any similar purpose, the State Government may, by notification in the official *Gazette,* add to or alter any of the Schedules and any such addition or alteration shall have effect as if it had been made by this Act.

Defence of life and property.

50. Subject to the provisions of sections 38 to 40 (both inclusive), nothing in this Act shall prohibit—

(*1*) the killing or capturing of any wild animal or wild bird by the occupier of any land in defence of the standing crop or cattle on the land;

(*2*) the killing or capturing in good faith of any wild animal or wild bird in defence of himself or of any other person:

Provided that nothing in this section shall exonerate any person who, when such defence became necessary, was hunting any game or committing any contravention of this Act.

Game Officers to be public servants (XLV of 1860).

51. All Game Officers and other officers exercising any of the powers conferred by this Act shall be deemed to be public servants within the meaning of section 2 of the Indian Penal Code.

Protection to persons acting in good faith.

52. No suit, prosecution or other legal proceedings shall lie against any person for anything which is in good faith done or intended to be done under this Act.

Power to exempt.

53. The State Government may by notification in the official *Gazette* exempt any person by name or in virtue of his office or any class of persons from all or any of the provisions of this Act.

Repeal (VIII of 1912).

54. The Wild Birds and Animals Protection Act, 1912, in its application to the State of Bombay, is hereby repealed:

Provided that any licence granted under the said Act and in force on the date of commencement of this Act shall continue to be in force and be deemed to have been granted under section 13 of this Act.

SCHEDULE I.

Vermin.

English.	हिंदी ।	मराठी.
Mongoose (*Herpestes* spp).	नेवला ।	मुंगुस.
Civet cats (*Paradoxurus*, *Viverra* and *Paguma* spp.).	मुश्क-बिल्ली ।	ताडमांजर.
Wild Cats (Felidæ) excluding Tiger, Lion, Panther & Cheetah.	रान-बिल्ली ।	रानमांजर.
Wild Dog (*Cuon dukhunensis*).	ढोलया या सोहना ।	रानकुत्रे.
Wild Pig (*Sus cristatus*).	जंगली सुअर ।	रानडुक्कर.
Rodents (Rodentia) except Hares—(*Lepus* spp.), Giant Squirrels (*Ratufa* spp.), and Flying squirrels—(*Petaurista* spp.).	रदन्त प्राणी, खरगोश और बड़ी और उड़ती गिलहरी के सिवा ।	रदन्त प्राणी, ससे आणि मोठ्या व उडत्या खारी खेरीज करून.
Jackal (*Canis aureus*).	सिआर ।	खोकड (कोल्हा).
Monkeys (Cercopithecidæ and Colobidæ.)	बंदर ।	माकड.
Bats (Chiroptera).	चमगादड ।	वाघळे.
Crows (Corvidæ).	कौआ ।	कावळे.
Birds of Prey (Accipitres) excluding vultures (Aegypiidæ).	शिकारी चिड़ियाँ गीध सिवा ।	शिकारी पक्षी गिधाडे खेरीज करून.
Parakeets (Psittacidæ).	तोता ।	पोपट.

SCHEDULE II.

Small Game.

English.	हिंदी।	मराठी.
Spot-bill (*Anas poecilorhyncha*).	बेर या गुगरल।	स्पॉटबील बदक.
Nukta (*Sarkidiornis melanotos*).	नकटा।	नकटा.
Whistling teal, large and small, (*Dendrocygna fulva* and *D. javanica*).	सिहली।	आरी.
Cotton teal (*Nettapus coromandelianus*).	गिर्री।	आडी.
Pink-headed Duck (*Rhodonessa caryophyllacea*).	लालसिरां बदक।	लाल डोक्याचे बदक.
Great Indian Bustard (*Choriotis nigriceps*).	बदक और हंस।	बदकें व हंस.
Ducks, Geese, Swans (Anatidae) all kinds other than above.	जल-पक्षी।	जलपक्षी.
Water-birds [excluding Storks (Ciconiidæ) Egrets and Herons (Ardeidae)].	बगुला, बगुली के सिवा।	करकोचे, गायबगळे, पाणबगळे याखेरीज.
Bustards (Otididæ) excluding Great Indian Bustard (*Choriotis nigriceps*).	तिलोर, बड़ा तिलोर के सिवा।	तिलोर, मोठ्या तिलोराखेरीज.
Sandgrouse (Pteroclidæ) of all species.	भट-तीतर।	भटतीतर.

Spur-fowl (*Galloperdix spadicea*).	कुकडी ।	चकोत्री किंवा खेकमी.
Jungle-fowl (*Gallus sonneratii*).	जंगल-मुरग़ी ।	रानकोंबडी.
Partridges, Grey and Painted (*F. pondicerianus* and *F. pictus*).	तीतर ।	तीतर किंवा चितूर.
Quail (*Coturnix*, *Perdicula*, *Cryptoplectron*, *Excalfactoria*; Turnicidæ) all species.	लवा या बटेर ।	लावी.
Pigeons and Doves (Columbidæ) all species.	कबूतर और फाकता ।	कबूतरें, कवडे व होले.
Hares (*Lepus* spp.) all species.	ख़रगोश ।	ससा किंवा जीवर.
Nilgai (*Bosephalus tragocamelus*).	नीलगाय ।	नीलगाय.
Black Buck (*Antilope cervicapra*) males only with horns over 12″.	हरण ।	काळवीट (हरण).
Chinkara (*Gazella bennetti*), males only.	चिंकारा ।	चिंकारा.
Four-horned Antelope (*Tetraceros quadricornis*).	चौशिंगा ।	चौशिंगा.
Barking Deer (*Muntiacus muntjac*).	भेकर ।	भेकड.
Hyænas (*Hyaena hyaena*) and Wolves (*Canis lupus*).	लगड़ और भेड़िया ।	तरस व लांडगा.

SCHEDULE III.

Big Game.

English.	हिंदी ।	मराठी.
Sambar (*Rusa unicolor*) males only with hard horns over 30″.	सांबर ।	सांबर.
Cheetal (*Axis axis*) males only with hard horns over 20″.	चितल ।	चितळ.
Panther (*Panthera pardus*).	बघेरा ।	बिबळ्या वाघ.
Tiger (*Panthera tigris*).	बाघ ।	वाघ.
Sloth Bear (*Melursus ursinus*).	रींछ या भालू ।	अस्वल.
Cheetah (*Acinonyx jubatus*).	चित्ता ।	चित्ता.

SCHEDULE IV.

Special Big Game.

Elephant (*Elephas maximus*)—at least one tusk 18″ outside the socket.	हाथी ।	हत्ती.
Bison (*Bibos gaurus*) horn measurements must reach at least one of the limits (*a*) a span of 33 inches, between the outer edges of the horns at their widest spread, (*b*) a girth of 18″ at the base of the horn.	गोर ।	गोर किंवा गवा.
Lion (*Panthera leo persica*).	सिंह ।	सिंह.

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